MODERN PLASTICS

APRIL 1960

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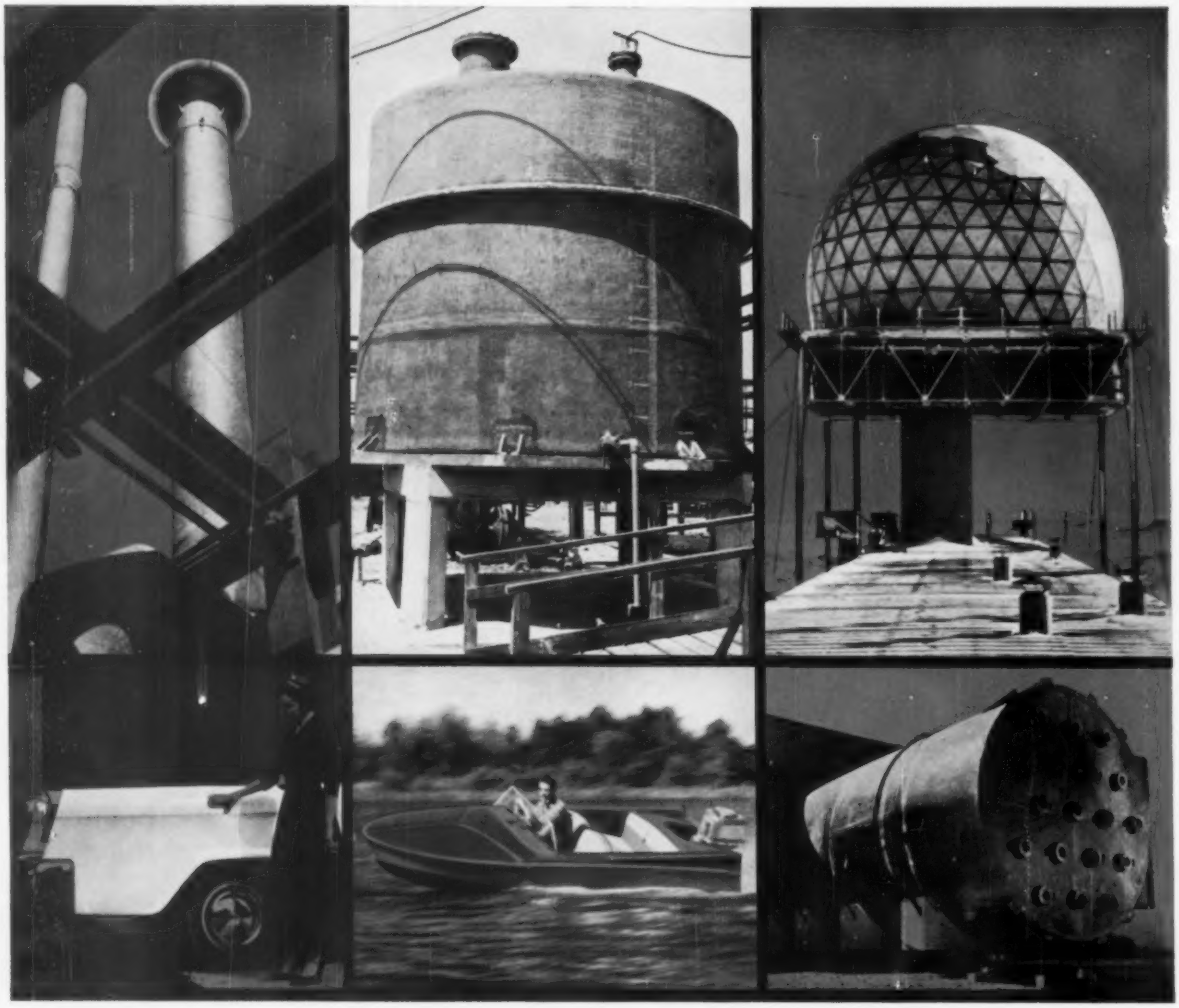

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PLASTICS*

APRIL 1960
Volume 37 Number 8

• ENGINEERING

• TECHNICAL

• DEPARTMENTS

Coming Up . . .

Many new markets are becoming available to plastics through the introduction of "tailor-made" copolymers and alloys. To bring these markets into focus and present the latest developments in these materials is the purpose of our May lead. . . . The complete story on the first all-plastics typewriter chassis will point out its impetus on the whole office equipment field. . . . Engineering articles in May will deal with design and construction of largest RP radome. . . . A simple equation to determine true material cost in plastics processing. . . . The Technical Section will present results of a long-term study on plastics pipe. . . . In the works for June is the first of two articles spelling out the complete picture on custom molding of expandable polystyrene, how to get into it. . . . Also in preparation are features on markets and potentials for film laminations . . . vinyl uses in building . . . recent developments in materials for lighting applications. . . . What you should know about winding operations . . . permeability of fluorocarbons.

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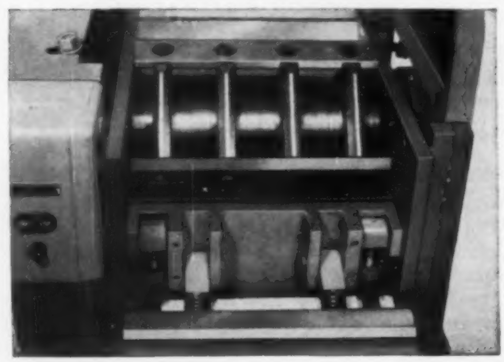

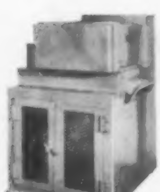

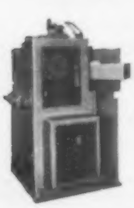

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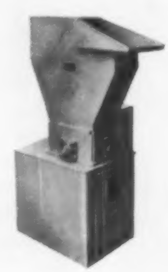

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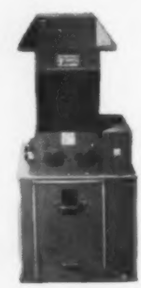

M-200
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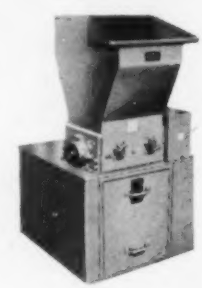

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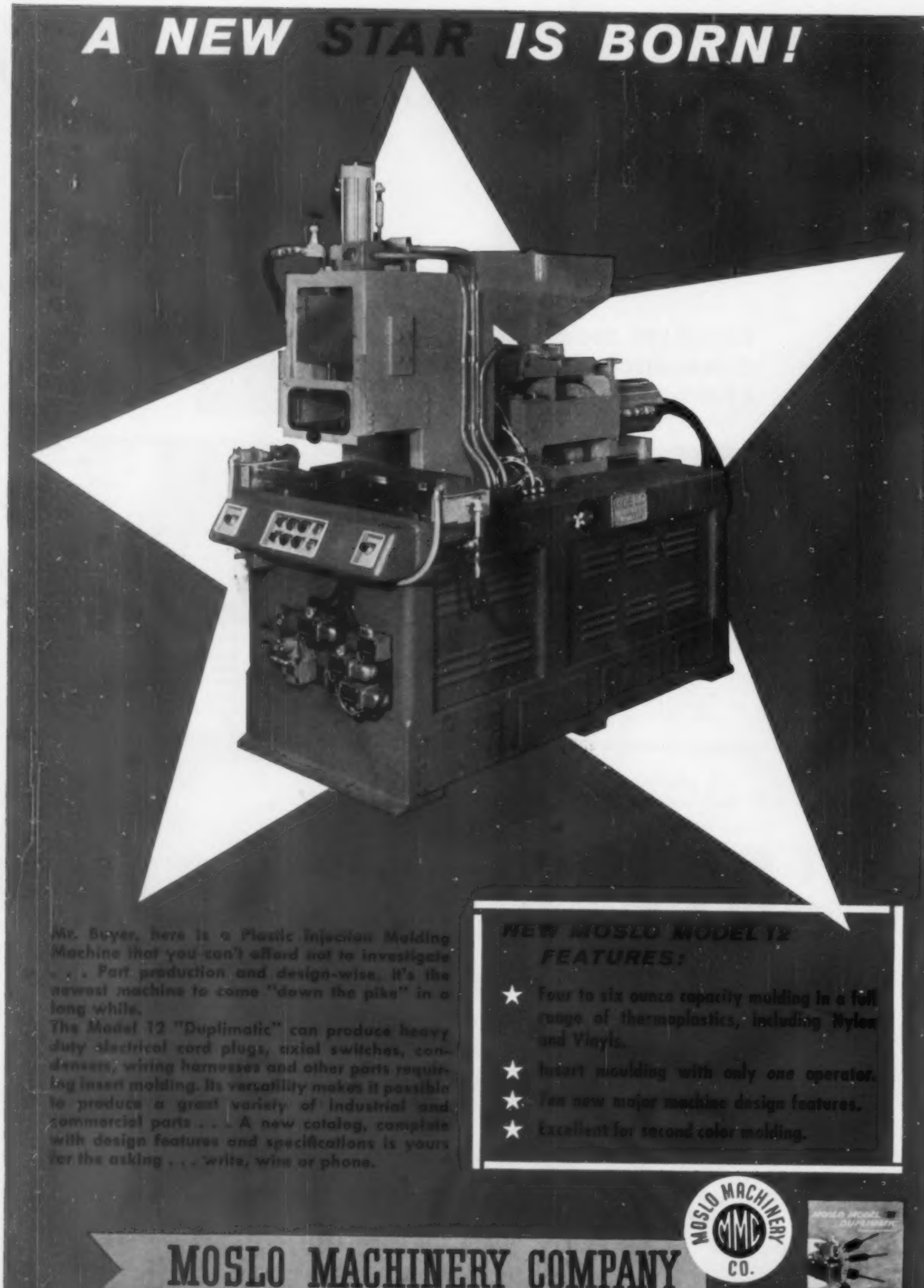
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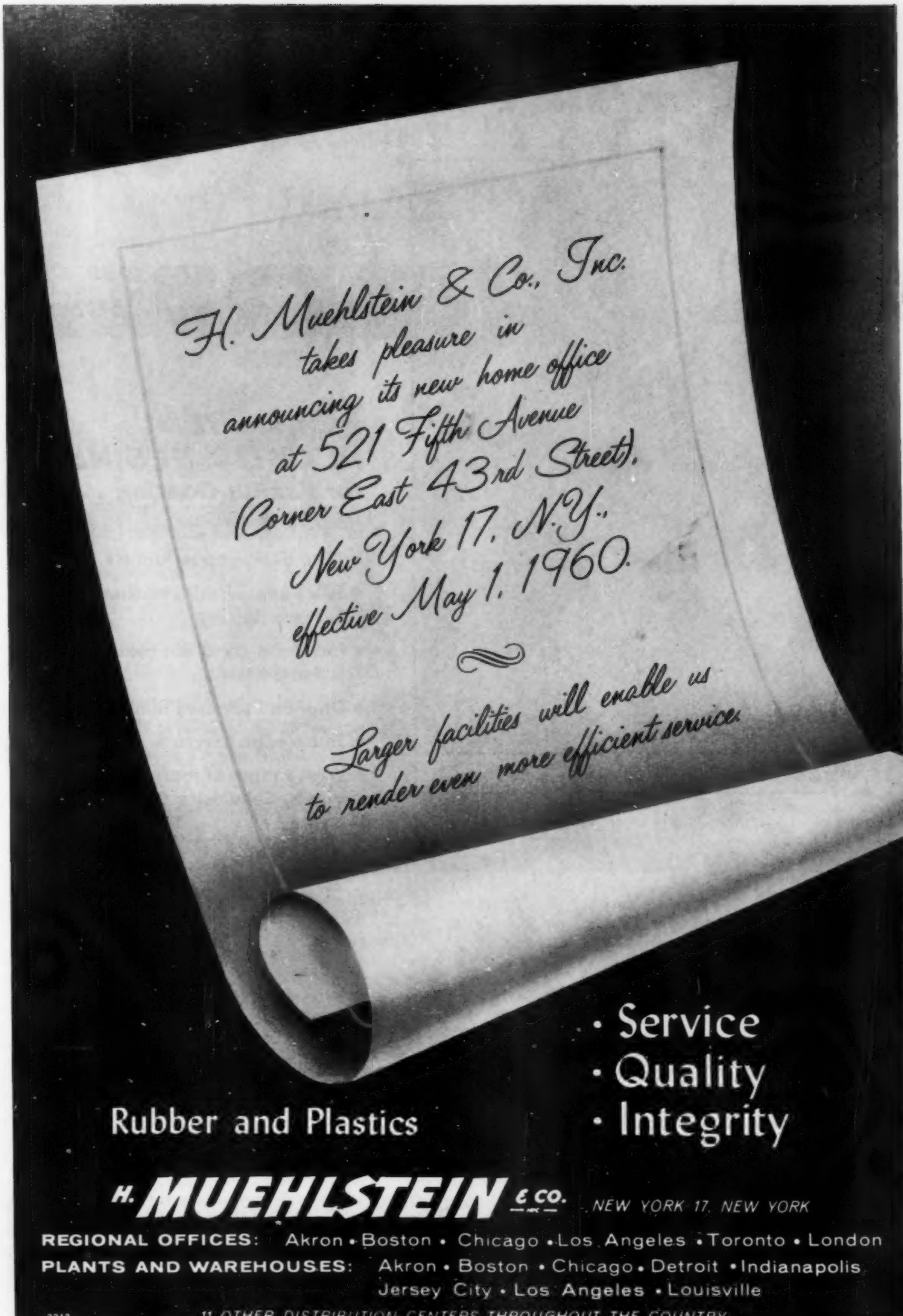
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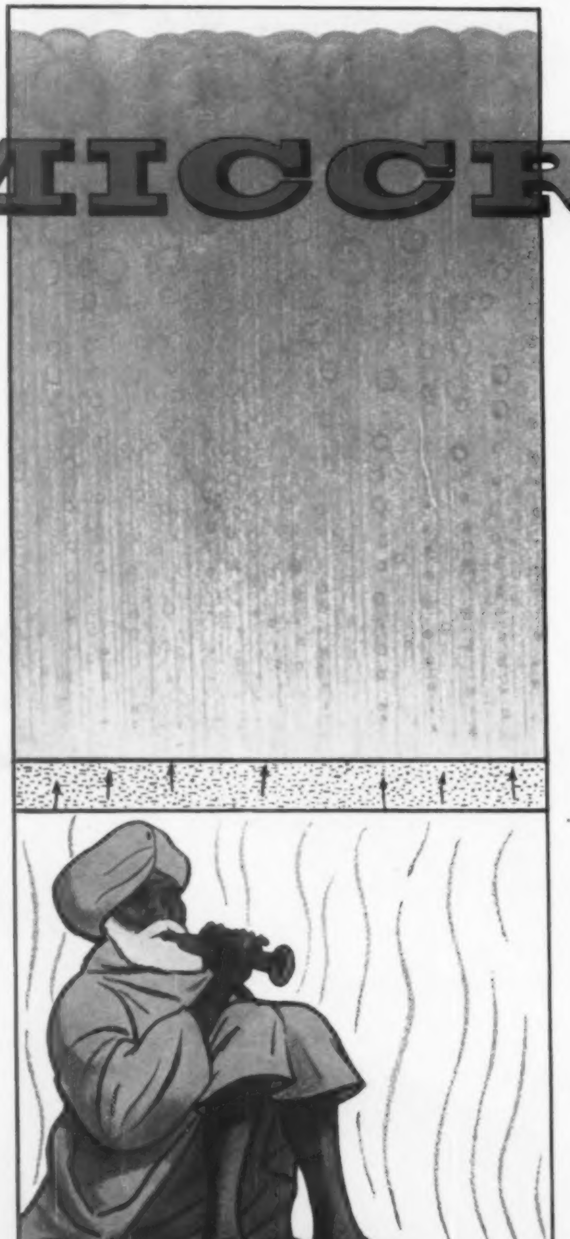

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Miccron Resins give you the physical and chemical advantages of these plastics in colorful, attractive coatings; applied by flocking, spraying, or the fluidized-bed process.

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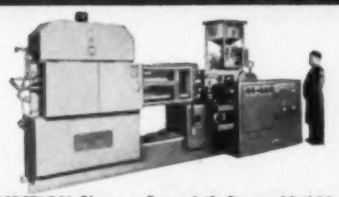

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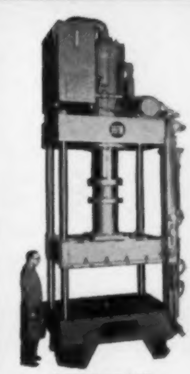

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GUIDED PLATEN—Assures accurate alignment.

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FAST RAM APPROACH—Allows for fast closing and return of movable platen. Slows automatically as work is approached.

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ADJUSTABLE STROKE CONTROL—Provides for automatic ram slowdown before contacting work.

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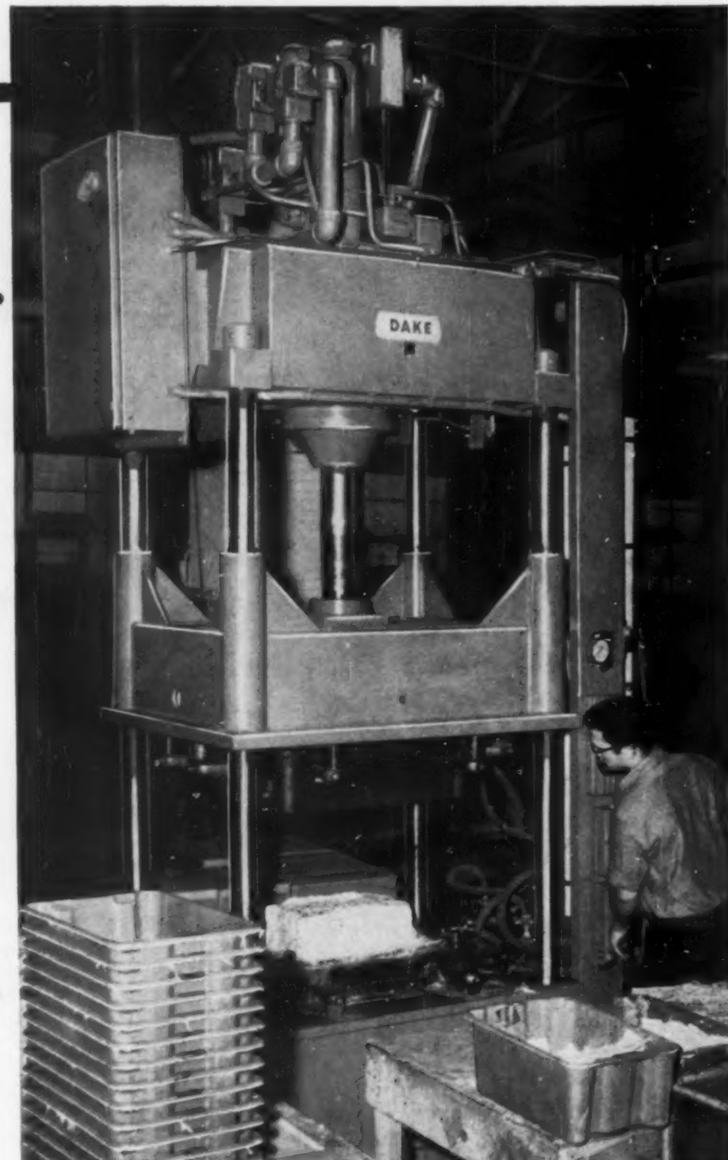

75-Ton Dake Guided Platen Plastic Molding Press forming Stack-n-Nest tote pans at G. B. Lewis Company, Watertown, Wisconsin.

Dake Guided Platen Presses are the latest development in the reinforced plastic molding field. They are job engineered to help you meet all molding requirements, as well as speed production output, and reduce operating costs. Their all-steel construction with long tie rod bearings and larger diameter tie rods provide maximum rigidity to assure extremely accurate work with all types of plastic forms. Standard models are electric-hydraulic in operation and available in capacities from 25 tons to 600 tons. Write for Bulletin 405.

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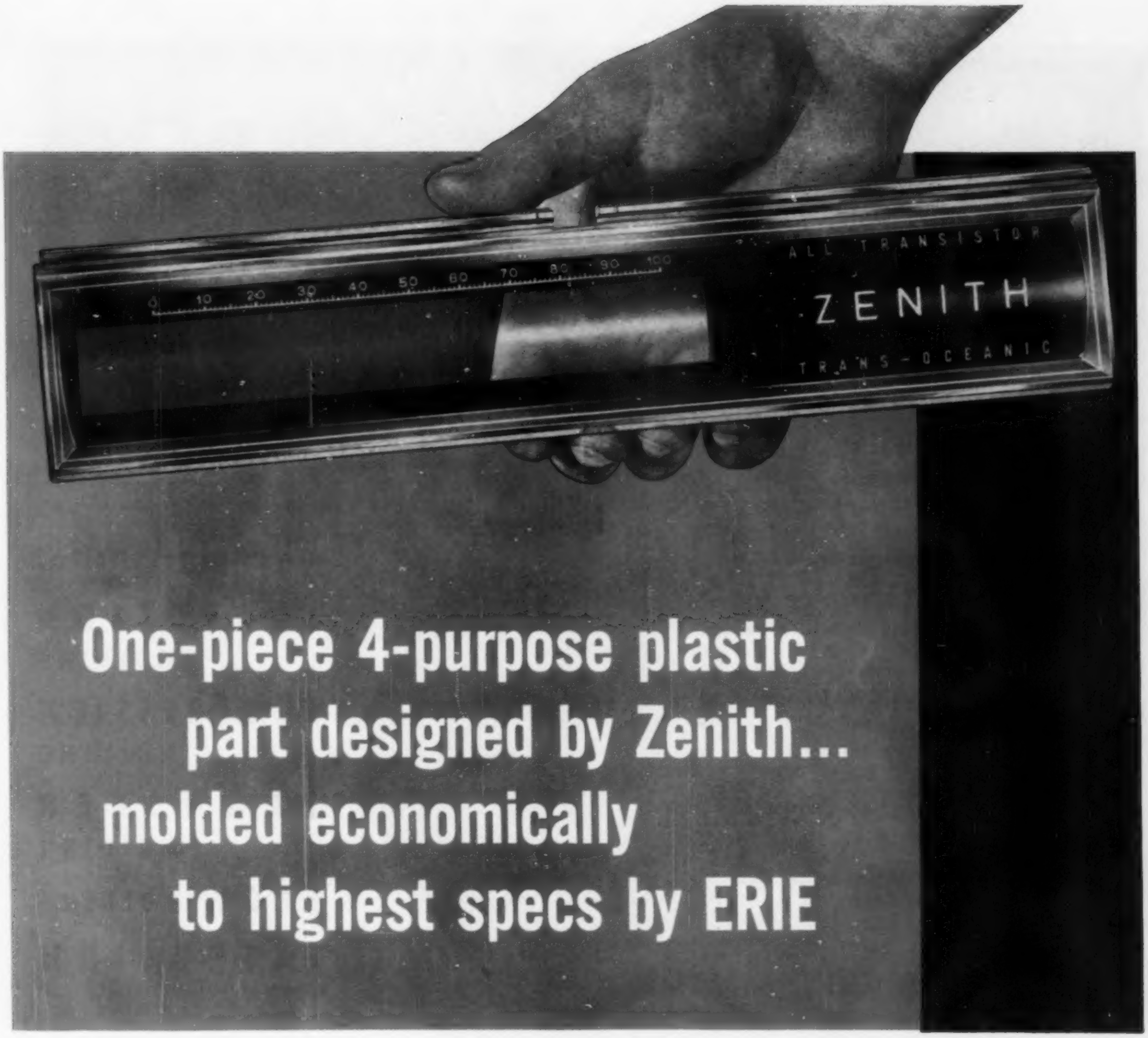

ERIE-*nomics at work...*

This one-piece plastic part designed by Zenith® for their "Trans-Oceanic"® Portable Radio is formed all at one shot by Erie's Plastic Division as an ERIE-nomical molding.

The clear plastic area magnifies where dial numbers must be read. The attractive name-plate is molded in colorful 3-dimension. And the "metal" frame is actually molded plastic that is metallized.

Zenith designers reduced assembly operations to a minimum by using this single ERIE-nomic molded part instead of multiple assemblies. At Zenith, they merely put this complete piece in position, fasten it with push-on fasteners, and the job is done . . . better, easier, at lower cost.

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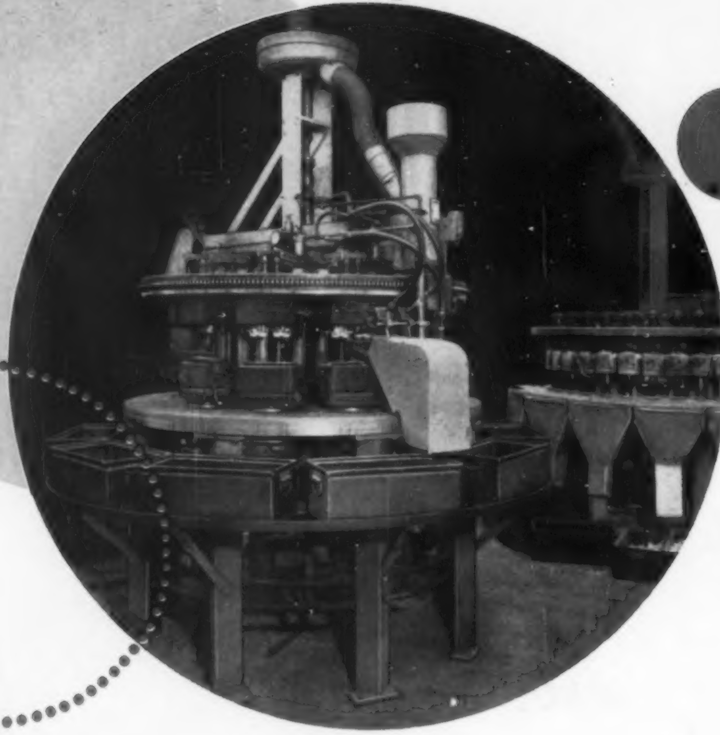

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For descriptive bulletin or opportunity to see these machines in operation, contact

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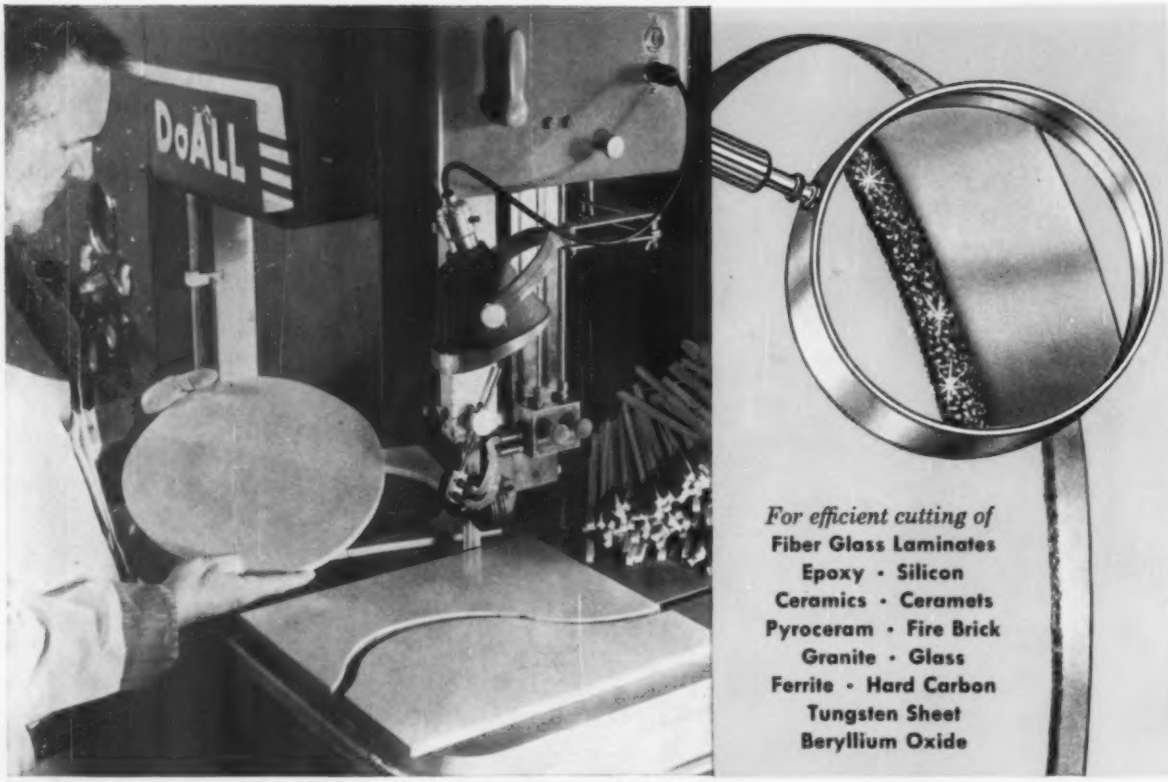

Now, from DoALL

This New Dia-Chrome Diamond Coated Blade Cuts Reinforced Plastics Better

A clean, smoothly finished edge and sharply reduced over-all costs are now possible in sawing hard-to-cut, glass-reinforced plastics. This new Dia-Chrome Band saws fiber glass, melamine, epoxy, polyester, silicone, phenol-formaldehyde, glass-bonded mica and similar materials. And you'll get phenomenal cutting rates on straight and contour cuts with unequalled accuracy.

The new Dia-Chrome Diamond-Coated Blade is unlike all other band-saw blades. Its cutting edge is composed of diamonds—held in place by a special process which prevents chipping and peeling as the band flexes over the saw carrier wheels at speeds up to 3000 f.p.m.

Whether your cutting problems include glass-reinforced plastics, ceramics, pyroceram or other hard-to-cut materials, call your nearby DoALL Sawing Specialist. His expert help and the services of the DoALL Demonstration-Test Center are free.

DoALL SAW BANDS cut every metal and material

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Available in carbon alloy steel or Demon® HS Steel

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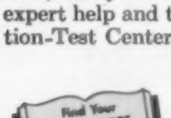
DoALL bands also available in knife and scallop and wavy edge styles. Also, special types for filing and polishing, as well as Dia-Chrome circular saws, hole saws, etc.



The DoALL Company, Des Plaines, Illinois

This is a typical DoALL Store

U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

APRIL, 1960 U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

A new polyethylene pouch-in-carton has been adopted by a west coast food concern for packaging frozen fruits in syrup. According to company officials the new container saves 35% over previous packaging costs for lithographed composite fiber-metal containers.

The package consists of a 2.75-mil heat-sealed polyethylene pouch inside a standard lock-tab folding carton with overwrap. The firm reportedly uses a continuous pouch forming-filling-sealing machine which turns out 3,000 pouches per hour.

Retailers are said to like the conventional size and shape of the overwrapped packages. Consumers like the fast, leak-proof thawing and ease of opening offered by the new frozen food container. Thawing time for the pouch pack is said to be only 9½ min. in 100°F. water, as compared with 45 min. for conventional fiber containers.

Now, scented polyethylene for packaging, molded items: a new dimension—aroma—has been added to polyethylene packaging films and molded items. Crystal-clear polyethylene films now can be made to create packages that pleasantly affect the senses of both sight and smell. This added sensory dimension is expected to stimulate sales still further for items packaged in polyethylene.

A wide variety of scents have already been developed, including such aromas as "clean linen" for fresh laundry packages, perfume for packaging women's lingerie, sweaters, handkerchiefs, and stockings, and lavender, tweed, cedar, pine, and spruce for men's sport clothing packages. Other aromas such as "cookie", "baked goods", spearmint, chocolate, lemon, orange, and lime will be offered by the manufacturer in the future, pending F.D.A. approval.

The fragrances are sold in the form of polyethylene/scent concentrates, which are dry blended with U.S.I. PETROTHENE film grade resin in making scented film. Between ¼ and 2% of scented polyethylene concentrate is used, depending on the scent. The manufacturer of the scent concentrates claims to be able to scent resins of any density or melt index required by the extruder, and that all aromas become an integral part of the polyethylene film—they cannot be washed away.

U.S.I. Opens Polyethylene Housewares Exhibit

An educational exhibit, designed to show retailers and manufacturers how quality polyethylene housewares are made was recently opened by U.S.I. The exhibit is located in the Housewares Building, 1150 Broadway or 230 Fifth Ave., New York City.

Occupying a space in the building's main lobby, the exhibit tells the story of polyethylene from manufacture of quality resin to production of quality goods through modern molding techniques. The display includes photos of plant facilities and samples of fine molded houseware articles.

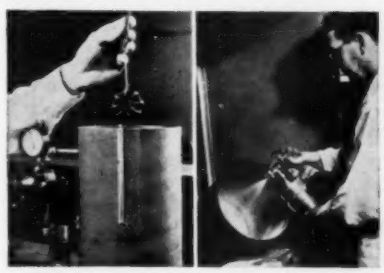
U.S.I. Introduces "MICROTHENE" Finely Divided Polyethylene

Resin in Powder Form Expected to Expand Use of Polyethylene in Textile, Metal and Many Other Fields

Polyethylene in finely divided or powdered form is now being produced by U.S.I. and is available in sample and semi-commercial quantities under the tradename "MICROTHENE". Already in use in Europe, finely divided polyethylene is expected to open many new markets for the resin in this country and to expand a number of existing ones. Some of the applications foreseen include its use in the coating of metal, textile, paper, glass and wood products, as a binder for non-woven fabrics, and as molding powder for production of large polyethylene items such as boats, tanks, and shipping drums.

Methods of Application

In coating operations, MICROTHENE polyethylene can be applied to the substrate in its original powder form, as an organic or aqueous dispersion, or as an organic or aqueous paste. The method selected depends largely on the substrate to be coated, the major requirement being that the substrate be able to withstand the heat necessary to fuse the resin into a continuous coating. In the coating of woven and non-woven fabrics, dry polyethylene powder or a paste is generally spread evenly onto a moving web, which then passes through an oven to sinter the plastic into a film coating. Metal parts can be coated by spraying, dipping, or slush coating with either the dry powder or dispersions. Organic dispersions are generally used on metals that would be corroded by water. With modifications of application techniques, strippable polyethylene metal coatings may be possible.



Two methods for coating metal with MICROTHENE finely divided polyethylene are shown above. Hot object is dipped in fluidized bed of powdered resin, left. Resin dispersed in organic liquid is applied by ordinary spray equipment, right.

Fluidized Bed Technique

Irregularly shaped objects, wire, and other metal items can also be coated with inexpensive equipment employing the fluidized bed technique. The item is first preheated, dipped into a container with the fluidized dry powder, and then cooled or post-heated to achieve a smooth, continuous coating.

Plastic Moldings

Another potential market for MICROTHENE finely divided polyethylene is in the field of large plastic moldings. The powder is poured into heated molds which shape the polyethylene as it melts on the surface of the mold. Excess powder is then poured out. The molds required are extremely simple and inexpensive. Large containers, drums, and even small boats have been made successfully by this technique in Europe.

Two MICROTHENE Resin Types Available

U.S.I. is initially marketing two types of MICROTHENE polyethylene. One type will be similar to PETROTHENE 202 resin (melt index 22, density 0.916); the other type will be similar to PETROTHENE 206 resin (melt index 5, density 0.924). As new market requirements develop, other types of resins will be made available in finely divided form by U.S.I.

Each of the above resins is available in two forms: fine (smaller than 200 mesh) which is made by a solution process; and coarse (50 to 100 mesh) which is made by a mechanical grinding method. Both types of powder will have their own fields of application.

Production Facilities

U.S.I. is now producing MICROTHENE polyethylene at Tuscola, Illinois, site of one of U.S.I.'s two polyethylene plants. The plant, which went on stream in March, has an initial capacity of 2 million pounds per year and is designed for fairly rapid expansion.

Samples of MICROTHENE finely divided polyethylene, and a Technical Data Sheet giving detailed product information may be obtained by writing U. S. Industrial Chemicals Co.

U.S.I. Announces Booklet On Polyethylene Printing

"Printing of Polyethylene" is the title of a new U.S.I. booklet just off the press. It's the latest addition to special U.S.I. literature designed to help achieve finest results with polyethylene packaging film.

The new booklet discusses methods of film treatment, printing techniques, printing inks, and field test procedures. It also contains a glossary of commonly-used ink and printing terms.

A copy of this valuable 16-page booklet is available upon request. Just write to U. S. Industrial Chemicals Co., 99 Park Ave., New York 16, New York.

POLYETHYLENE PROCESSING TIPS

U.S.I.

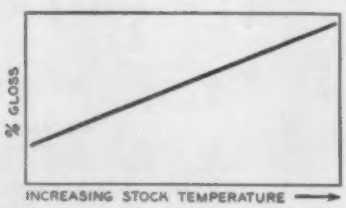
Series 5, No. 2

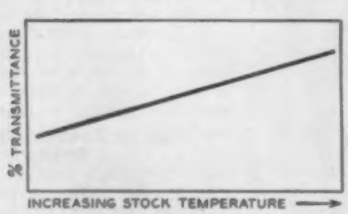
HOW STOCK TEMPERATURE AFFECTS THE OPTICAL PROPERTIES OF CAST FILM

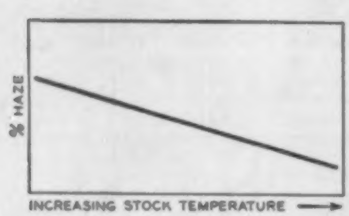
Stock temperature is a key factor among operating variables affecting the optical properties of cast polyethylene film. Fortunately, the extruder can control stock temperature with a high degree of accuracy to produce film of optimum gloss and transparency and minimum haze.

Gloss is generally defined as the percent light reflected at an angle from the surface of the film, as determined by standard measuring techniques. Transparency, or transmittance, is the percent light which will pass through the film. Haze is the percent light scattered as it passes through the film.

The graphs below show the general effect on these vital optical properties with changes in stock temperature.



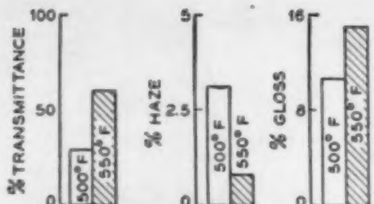




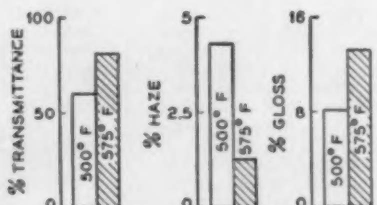
Effect Varies With Resin

Within limits, the amount of change in the film's optical characteristics brought about by raising or lowering the temperature varies with the resin being processed. In some cases, for example, improvements of 50% or more in gloss and transmittance result from increased temperature. Similarly, a 75% reduction in haze is sometimes possible. These results are much greater than would be expected from the above graphs of the general effect.

The following bar graphs show examples where temperature increases of 50°F and 75°F greatly improved the clarity of films of two different resins.



"PETROTHENE"® RESIN A: MELT INDEX 2.0, DENSITY 0.928



"PETROTHENE"® RESIN B: MELT INDEX 8.0, DENSITY 0.915

These differences in films produced at different temperatures also underscore the need to keep resin temperature uniform. (See U.S.I. Polyethylene Processing Tips, Vol. V, No. 1 for a detailed discussion of the importance of stock temperature control.)

Balanced Extrusion Conditions Necessary

In the production of cast film, the requirements of the end use are most often the major consideration. To achieve the desired film properties with the equipment available, the extruder must concern himself not only with stock temperature, but with the establishment of a balance of extrusion conditions and resin properties.

U.S.I. technical service engineers will be glad to work with you in determining the best stock temperature for your operation. Ask for their assistance on this or other processing problems.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
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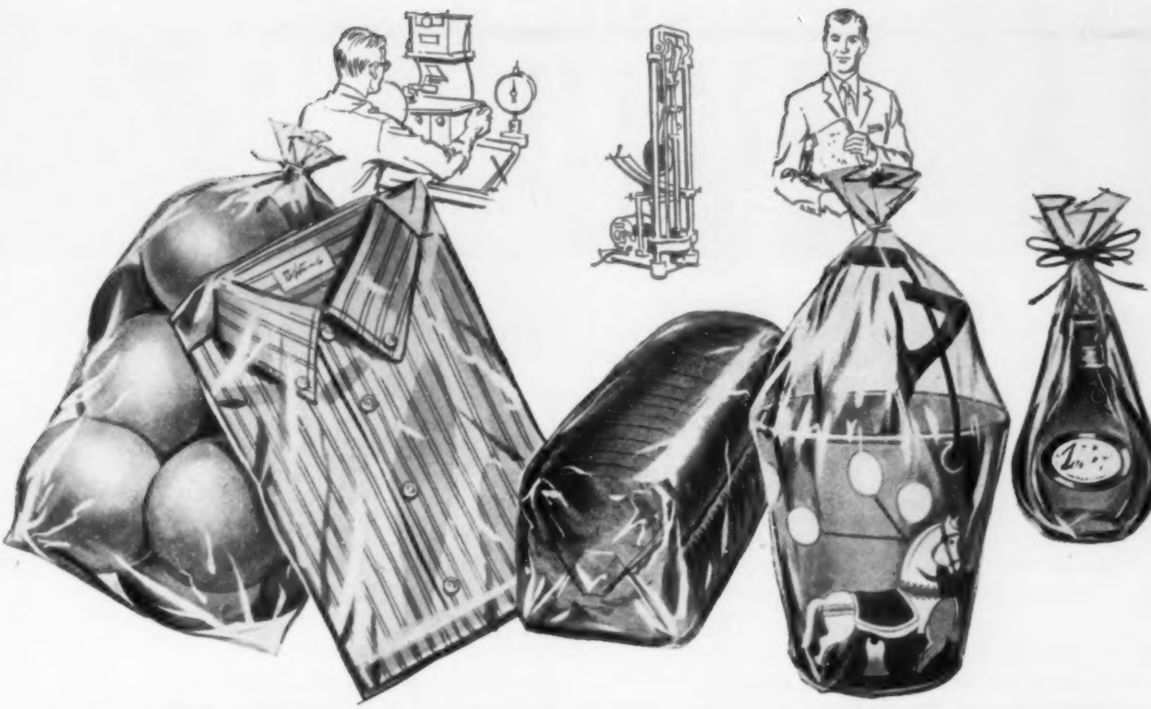

U.S.I. HELPS IMPROVE CLARITY OF POLYETHYLENE PACKAGING FILM

...helps expand your markets for it, too

From shirts to sugar cookies . . . your customers are finding their products look better, sell better when packaged in polyethylene. You can now produce polyethylene film with better clarity than ever before thanks in large part to these U.S.I. research and development services:

FINER RESINS

U.S.I. has developed a number of different PETROTHENE® resins . . . so that you can produce polyethylene film with a complete range of toughness and clarity to suit any end use. These resins are manufactured under rigid quality control conditions to assure resins of the highest uniformity for packaging use. To help you obtain maximum results from these resins, U.S.I. offers literature containing tables and technical information to assist you in choosing the most suitable resin for your particular applications.

NEW PRODUCTION TECHNIQUES

Engineers at U.S.I. are constantly seeking methods for producing better films with PETROTHENE resins. The clearest polyethylene film available today is made by a chill-roll casting process which U.S.I. pioneered. Cast film offers unprecedented clarity and gloss without sacrificing needed strength. Since its development, the process has sparked many new uses for polyethylene film.

U.S.I. has also contributed to higher clarity in blown tubular film with a new annealing chamber technique for film extrusion. When properly used, the technique produces blown film of markedly improved clarity, with practically no impairment of other physical properties.

TECHNICAL ASSISTANCE

A Polymer Service Laboratory is maintained by U.S.I. to help extruders solve production and processing problems. Experienced Technical Service Engineers will be glad to work closely with you on evaluating new resins and assist you in any processing problems. This service is confidential and without obligation.

A wealth of technical literature is also available from U.S.I. to help you take full advantage of the quality of PETROTHENE resins. These booklets cover many phases of processing and use of polyethylene and are available upon request.

ADVERTISING AND SALES PROMOTION

U.S.I. conducts a coordinated advertising and sales promotion program which is designed to help build markets for your polyethylene products. Advertisements directed to *your* customers and prospects appear in leading magazines in the baking, produce, candy, dairy, apparel and food fields. Other U.S.I. polyethylene packaging literature reaches film users and package designers regularly by direct mail.

U.S.I. ads appear in leading magazines to help build your markets for polyethylene film.

U.S.I. INDUSTRIAL CHEMICALS CO.

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GUIDE TO LITERATURE ON

PETROTHENE

POLYETHYLENE RESINS

U.S.I. offers a wealth of literature on its PETROTHENE Polyethylene Resins, ranging from complete processing information to sales and application advice on polyethylene packaging materials and molded goods.

Listed below are the titles currently available. We'll be happy to send you any that you select. Address your request to: U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corp., 99 Park Avenue, New York 16, New York, or to your nearest U.S.I. sales office listed below.

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- PETROTHENE Polyethylene — a Processing Guide
- Polyethylene Processing Tips File Folder
- Polyethylene "Shutdown" Resin — PETROTHENE 205-1
- PETROTHENE Resins 200-2, 201-2, 203-2 for Paper Coating
- Cast Film
- Annealing Chamber Improves Optical Properties
- Which Polyethylene Film Should I Use
- Polyethylene Bag Calculator (Domestic)
- Polyethylene Bag Calculator (Metric)
- Printing of Polyethylene
- Polyethylene, The Best Line Wire Covering
- PETROTHENE Resins for the Wire and Cable Industry
- Packaging and Shipping of PETROTHENE Resins

ARTICLE REPRINTS

- Cast Polyethylene Film
- How to make Roll-Chilled Polyolefin Films Commercially

LITERATURE FOR DISTRIBUTION TO YOUR CUSTOMERS

- Heat Seal Characteristics of Polyethylene Films and Coated Substrates
- Polyethylene Creates New Opportunities in Packaging
- The Goose That Laid the Golden Egg: Fable and Fact for Plastics Housewares Buyers
- How to Choose and Use Polyethylene Plastic Pipe
- Formulas and Tables for Polyethylene Film and Bags (English Units)
- Formulas and Tables for Polyethylene Film and Bags (Metric Units)

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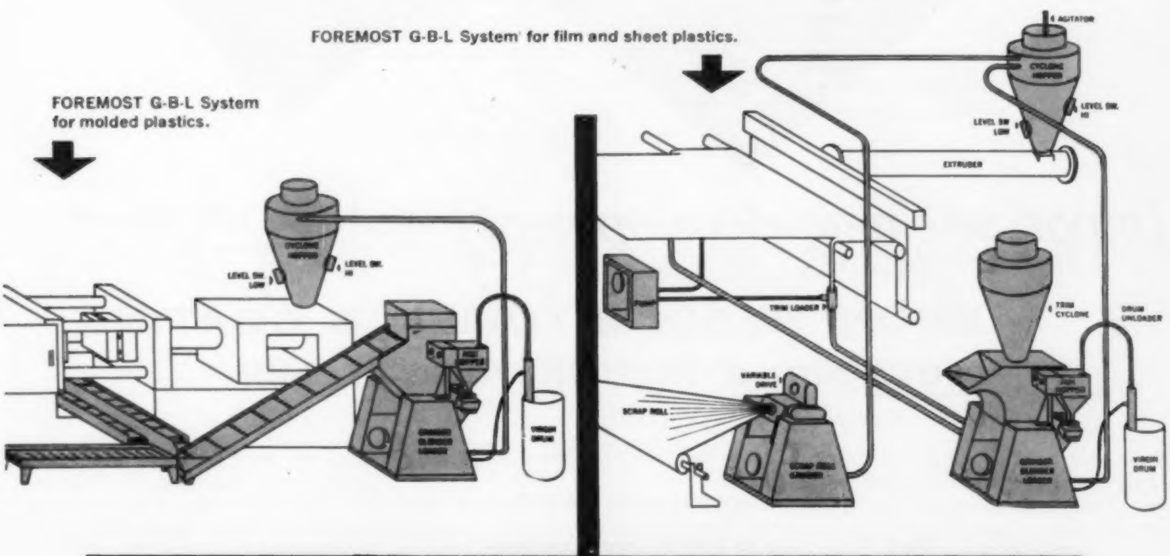

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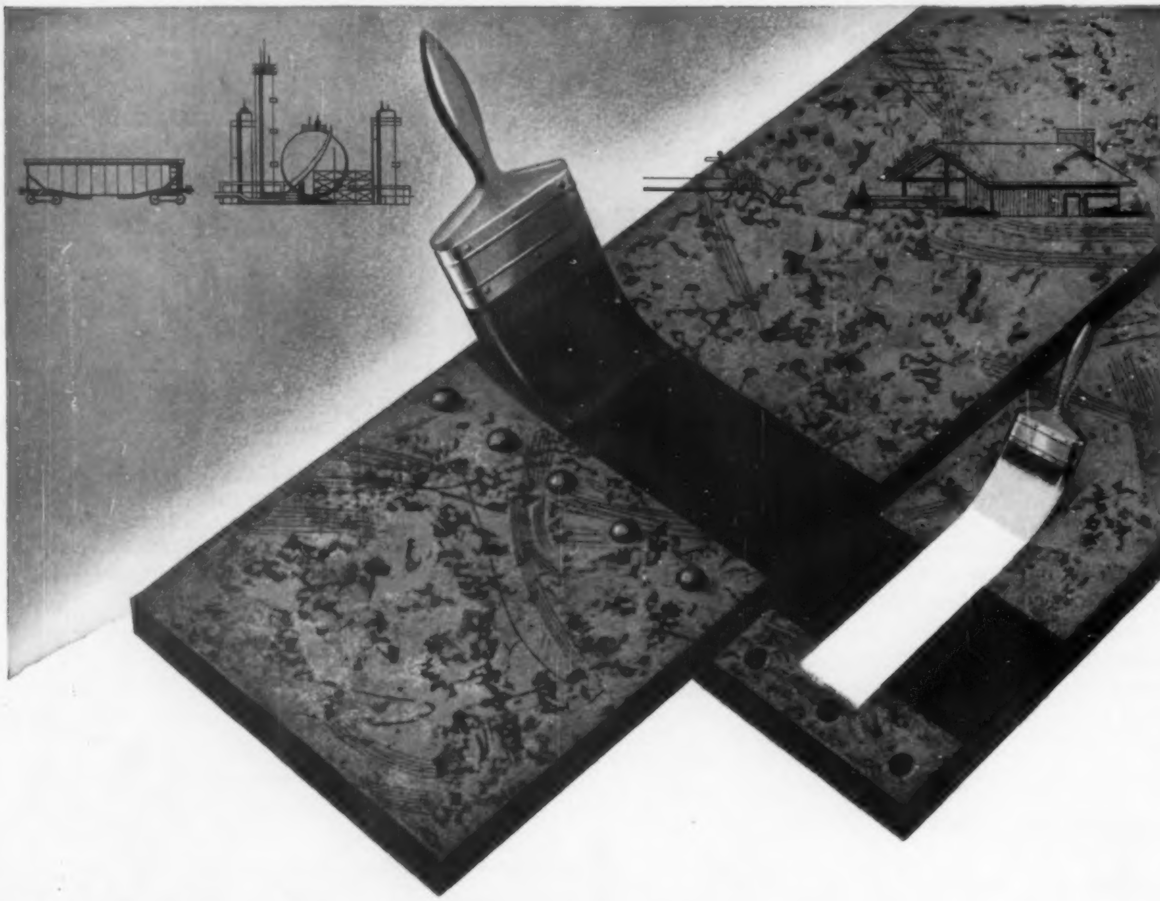


THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 1

April 1960

Vinyl chloride on the upswing. Vinyl chloride resin sales for the first quarter of 1960 ran well ahead of the same period in 1959, according to various sales managers. January and February of 1959 were in the low 60-million-lb. range —March was around 70. The first three months of 1960 will run well beyond those figures, it is believed.

But it will take more doing before volume exceeds the other months of 1959, when sales ran to a high of 82 million in October and never dropped below 70, except for 66 million in July. Total for 1960 could go over 950 million lb., but sales managers are hesitant to exhibit such optimism, even though 1959 increased somewhere between 150 and 200 million lb. over 1958.

Incidentally, the oft-repeated statements that "vinyls went over a billion" in 1959 needs interpretation. The Tariff Commission reports give a total of over a billion for "All vinyls" but over 200 million lb. include such resins as saran, polyvinyl alcohol, polyvinyl butyral, polyvinyl acetate, and others. Vinyl chloride is in the 800- to 900-million-lb. range and represents an industry in itself. Its uses are totally different from the so-called "other vinyls." It should be kept separate from the miscellany.

Uncertainty of vinyl chloride totals for 1959. Market analysts and sales managers differ in their opinions concerning the accuracy of the Tariff Commission's total of 858 million lb. of vinyl chloride consumed in 1959. The dissenters believe that there may be some duplication in reports sent to the government, as they relate to resins for film, sheeting, and coated fabric.

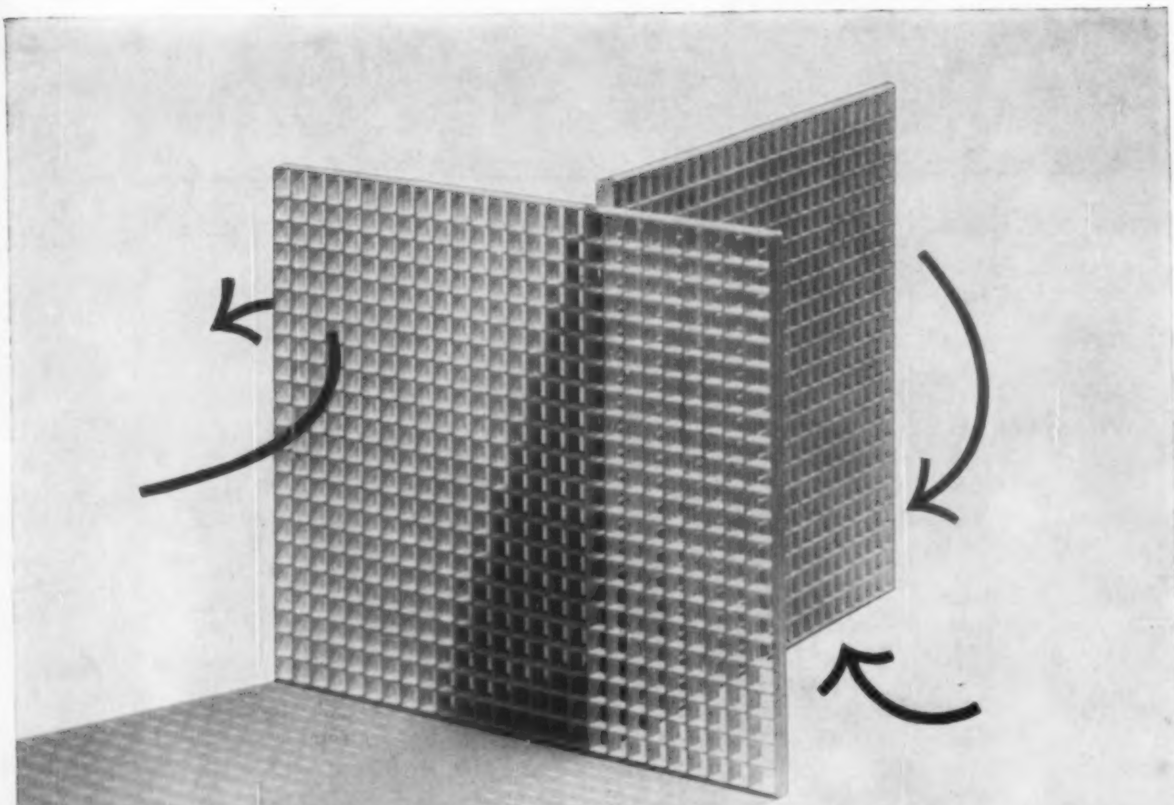
A usually reliable report submitted to this magazine indicates that 165 million lb. of vinyl resin were used for calendered, plasticized film and sheeting in 1959, with slightly more than half used for film. This would include the film used for laminates to cloth which sometimes gets mixed up with "fabric treatment." The government figure for resins used in film is 86 million, but includes 8 or 10 million that is extruded or cast.

The government total for sheeting is 126 million, but this includes an estimated 18 or 19 million unplasticized sheet and over 40 million lb. of resin for calender-coated fabric. This would leave 65 or 70 million lb. for calendered, plasticized sheeting. There are many persons in the industry who believe this is a low figure.

The coating resin figure is most confusing of all. The government figure for textile and fabric treatment is about 65 million lb., but supposedly this does *not* include calender-coated fabric, although some of it may have slipped in. The MODERN PLASTICS estimate for vinyl resin in coatings is: between 40 and 45 million for calender coating; somewhere around 35 million for spread coating; a few million lb. for prime coating before the plastisol is applied and for saturation of unwoven fabric or cellulose; and from 10 to 15 million for paper coating and kindred applications.

The huge figure of 95 million lb. of resin for "mis- (To page 41)

*Reg. U. S. Pat. Off.



This molded plastic light diffuser is non-combustible...meets new fire codes

The Guth Gratelite Louver Diffuser, molded in 2′ x 2′ modular units, provides a ceiling of glareless, shadowless light. But it is necessary that it be non-combustible in order to meet certain fire code ordinances.

This intricate molding problem was solved by the development of a special thermosetting urea plastic which would flow easily for the compression molding of the $\frac{3}{8}$″ cubical openings and still retain the required light diffusion qualities.

Approved by Underwriters Laboratories, accepted and recommended by architects and lighting engineers, the Guth Gratelite Louver Diffuser is meeting with tremendous success.

This is another CMPC "White Gloves" molding. For maximum protection against material contamination, this product was molded under highly controlled production conditions involving special dust control measures and a protective materials handling system. This is another example of CMPC's specialized techniques and facilities for producing the best in molded plastics.

CMPC

CHICAGO MOLDED PRODUCTS CORPORATION
1020 A North Kolmar Avenue
Chicago 51, Illinois

(*Continued from page 39*)

cellaneous vinyl chloride resins" includes around 30 for export, a large quantity of off-grade resin, and probably a good quantity that is used for film or sheet. Some companies who report their total sales aren't too careful about separating them into different end uses.

What the coaters are doing. The Vinyl Fabrics Institute of N. Y., which represents a large group of processors who calender and coat vinyl chloride products, states that 1959 showed an increase of 23% over 1958 for vinyl coated products—the peak volume year for the industry. The Association makes no effort to speak for the whole industry—their figures represent 20 firms. Most of the large fabric coaters are included in these statistics, but the coverage of the unsupported vinyl sheet and film producers is by no means complete.

The members report that the linear yards of vinyl coated fabrics grew from around 92 million in 1955 to about 95 million in 1959. Pyroxylin-coated fabrics declined from 28 million linear yd. in 1955 to 21.5 million in 1959. The pyroxylin figure indicates that once a plastic is established, it always manages to find markets where it fits better than anything else.

The vinyl unsupported sheeting produced by this group declined from 52 million sq. yd. in 1955 to 37 million in 1959, but, as noted above, it is only part of the industry; and it does not include the several million yards used for metal laminates.

Irradiated, shrinkable, polyethylene film. The Cryovac Div. of W. R. Grace & Co. has produced and sold more than a million lb. of irradiated, shrinkable polyethylene film in test marketing operations. It sells now for 3¢/1000 sq. in. which is comparable to cellophane and close to conventional polyethylene.

Irradiation increases its strength more than 500% and makes it possible to stretch the material in both directions more than 200%, according to W. R. Grace. After irradiation the film is biaxially oriented to impart shrink energy. When exposed to heat at 180° F., the film shrinks by 20 percent. Irradiation changes tensile strength from 2000 to 10,000 p.s.i. Clarity is claimed to be as good as any type of film.

Called Cryovac Type L, it was first used for packaging poultry. Over 10 million skinless frank packages used it last year. It is now being investigated for produce, even lettuce, with a shrink-sleeve packaging that is open on both ends. It is suggested as a shrink-on, skin tight cover over bakery products sold in aluminum trays. No seal is required for this latter application. It is also suggested for packaging of candy, paper products, record covers, pizzas, and window shades.

Exports and imports to U.S.S.R. and satellites. In a fourth quarter report to Congress on trade with the Iron Curtain countries in Eastern Europe, the United States Commerce Department included the following items which are of interest to the plastics industry.

Among the applications rejected for export to U.S.S.R. were fluorinated hydrocarbons such as Teflon ($28,615); polyethylene to Bulgaria, East Germany, and Russia ($442,361). These were supposedly (To page 43)

THE PLASTISCOPE

(*Continued from page 41*)

rejected because of a previously declared policy not to export products that were not easily available or would be useful for military purposes. Present capacity of polyethylene production in Russia is estimated at 10 million lb., and it is considered valuable for such applications as marine cable, coaxial cable, and similar uses.

The review board believes that PE is still difficult for Russia to obtain from other European countries. Approval for constructing a polyethylene pipe plant in Russia, using National Rubber Machinery equipment, was granted to Omni Products early in 1959.

There has reportedly been no request to ship such plastics as vinyl chloride or polystyrene behind the Iron Curtain. Since they are easily available in Russia it is assumed that such a request would be approved by the Commerce Dept.

Eleven export licenses for technical data were denied. All involved processes and plants in the petrochemical field, and covered ethlyene glycol and oxide, polyethylene, maleic and phthalic anhydride.

Styrene monomer approved for shipment. Among the items approved for shipment to Russia was $420,750 worth of styrene monomer. At 12¢/lb. that is only 3½ to 4 million pounds. The Russians apparently have a big surplus of benzene, from which styrene is derived, and export large quantities to the U. S. but do not yet have enough plants to produce a sufficiency of styrene for plastics, rubber, and detergents. The benzene coming from Batun in Russia is said to be about half from petroleum and half from coke ovens. Incidentally, it is believed that uses for benzene in all Europe will have increased so greatly in 5 years that it will become scarce and imports will be required.

Another chemical exported to Russia was $746,000 worth of isobutyl alcohol, which is used for butyl phthalate plasticizers and smokeless powder, among other applications.

New price for Implex. Following recent completion of expanded facilities, Rohm & Haas has announced a radical reduction in price of from 56 to 46½¢ for natural color Implex, an impact resistant, opaque, methyl methacrylate molding material. Price for color is 48½ cents. A merry competitive battle may be expected, with other thermoplastics in the 40¢ range, for markets not previously available because of a shortage of Implex.

This material has already taken over a major portion of the ladies' shoe heel market and has made serious inroads in the market for piano and business machine keys, because it doesn't stain, has good color, and pleasant "feel." It is expected to move into automotive interior applications, such as armrests and panels, especially if metallized colors are desired. Its use in telephones, outboard motor shrouds, pens, and pencils is expected. The material can also be extruded into sheet for pressure forming in thicknesses as low as 0.060 inch.

Oronite buys G.E. plant. Oronite Chemical has acquired the resin plant at Anaheim, Calif., formerly owned by General Electric. This is a (To page 45)

TITANOX® helps bring smiles to the kitchen

Rubber and plastic products bring smiles to the kitchen. And TITANOX white titanium dioxide pigments, in turn, bring smiles to compounders and processors of all types of rubber and plastics.

For TITANOX pigments, particularly TITANOX-RA, help maintain efficiency in production and uniformity of white and light colored products that make consumers happy.

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THE PLASTISCOPE

(*Continued from page 43*)

specialty type plant containing many small kettles, and it will be used primarily by Oronite as a demonstration and development plant to instruct and show customers how isophthalic can be used in the production of a wide variety of resins.

Phthalic anhydride again jumpy. The price situation in phthalic, an ingredient necessary in production of many plasticizers, polyesters, and alkyd paint resins, is confused again. At last account list prices varied from 17 to 21 cents. This is a most unusual occurrence in the chemical industry where companies generally play "follow-the-leader" in such circumstances. Degree of availability of napthalene to various phthalic producers seems to be one of the reasons for the variation.

One of the leading producers held tight at 25¢ after others had announced a 1¢ price rise. Probably he anticipated that all phthalic would soon be 17 cents. Those who advanced the price to 26¢ have stated that they will now sell at 25¢ to meet competition. With the present high demand for phthalic and the continued shortage of naphthalene, it seems difficult to believe that this present price situation can long endure. In the midst of this confusion, Oronite Chemical also raised the price of isophthalic to 18¢, but it is in tight supply. It is sometimes used to replace phthalic in DOP, where it is claimed to have lower volatility and less migration, but primarily it is channeled into the polyester and alkyd fields.

Fluorinated polyvinylidene chloride. Pennsalt Chemicals Corp., Philadelphia, Pa., is now producing pilot plant quantities and field evaluating a new fluorinated vinylidene chloride resin called RC-2525. It is essentially a crystalline high molecular weight polymer of vinylidene fluoride. Such a resin has never before been offered. It has high impact, does not shatter at low temperatures, has flexibility and long life, according to the company. It is suggested for pipe, tubing, seals, gaskets, and packings where corrosive materials are encountered. It is claimed to be easy to fabricate.

New kind of hook-up. A type of arrangement that seems different from any other yet tried in the plastics industry is that between Phillips Chemical and National Distillers, the parent company of U. S. I. Under this program, U. S. I., presently producing conventional high-pressure polyethylene from ethylene supplied by Phillips at the latter's Houston, Texas site, will now undertake to provide conventional high-pressure (low- and medium-density) polyethylene to Phillips Chemical.

The resin will be made according to Phillips specifications, will be delivered in bulk to Phillips plant, packaged there, and sold under the Phillips tradename of Marlex. In other words, U. S. I. is being hired to convert and manufacture Phillips ethylene into conventional low- and medium-density polyethylene that will be marketed by and carry the Phillips guarantee. Phillips will initially have 14 different resins in this classification.

For additional and more detailed news see Section 2, starting on p. 204

LETTERS TO MODERN PLASTICS

Where readers may voice their opinions on any phase of the plastics industries. The editors take no responsibility for opinions expressed.

Silicone maker identified

Sir: We were pleased to find in the February issue of your magazine an article on "One-shot urethane foam." The precise and informative article, with the valuable tabulations of formulae and properties, was of special interest to us since the Silicones Division has been actively participating in this rapidly expanding field for several years.

However, some confusion has resulted from the footnoted reference to Union Carbide Chemicals Co. as the manufacturer of the silicone surfactant for the process. This product Union Carbide L-520 Silicone Surfactant is manufactured by the *Silicones Division* of Union Carbide Corp. We would appreciate it if you could possibly bring this to your readers' attention.

We hope that you will present in the future more articles about the urethane foam industry, as it is a comparatively new field with unlimited possibilities.

E. R. Galli

Silicones Div.,
Union Carbide Corp.
New York, N. Y.

Training program in plastics

Sir: You may be interested to learn that I was contacted by the St. Regis Paper Co. of Bethesda, Md., and the Plastic Products Co. of N. Syracuse, N. Y., in connection with my letter to you of Nov. 30, 1959, which you printed in your January "Letters to Modern Plastics."

Nicholas R. Loope, Dir.

Joint Carpentry Apprenticeship Committee of Washington, D. C. and Vicinity.
Washington, D. C.

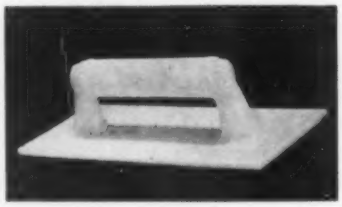
The January letter asked for assistance from plastics companies in setting up a training program in plastics for carpentry students.—Ed.

For epoxy flooring

Sir: We read with interest your article in your February issue on the use of epoxies as floor toppings.

It might be of interest to your readers that we produce a polyethylene trowel, developed especially for the firms that apply epoxies. Because of the recent interest as a floor cover, we have had many requests for the item. The non-sticking qualities of polyethylene, the hardness of linear polyethylene, as well as its resistance to corrosion, make this trowel extremely useful in this field.

Our standard size is 11¾ in. by 4¾ in. and has a large, comfortable handle. We are enclosing a picture of the item.



K. Landsberger

Bel-Art Products
Pequannock, N. J.

Let's educate the industry

Sir: I note Mr. Narsh's letter in your March issue (Let's educate the public, p. 44). Could it be that quality control in the plastics industry needs tightening if customer satisfaction is to be maintained? Here's a question which a business publication having the stature of MODERN PLASTICS might well wish to investigate more fully.

The reason for bringing it up is quite simple. Recently, while covering a story for one of our clients, we got into an "off the cuff" conversation with the plant foreman. "If only," he complained, "we could get materials that are the same from one batch to the next, how much easier our job would be. Just think; we specify a certain type of glass cloth, fully expect it to be 7 or 8 mil, and it arrives at 10 mil. Just what am I supposed to do when the wall thickness I need is 30 mil? In another case, prepreg 164 cloth, which is supposed to be 19 to 20 mil, comes to us 25- to 30-mil thick. How can we possibly control the quality of our own products when the raw material suppliers are so erratic."

We're sure he didn't mean to pick on the glass cloth manufacturers, because he quoted similar examples for resin viscosity, color, other physical properties, none of which seem to be reproducible from one batch to the next. We can sympathize with him; he has a problem. Frankly, we have no way to help him solve it. Can YOU do something about it? It would certainly benefit the entire plastics industry if you were to take up this crusade.

Lucien R. Greif

Greif Assocs. Inc.
New York, N. Y.

Flame resistant acetate

Sir: We were quite interested in reading your article appearing on p. 90 of the November issue of MODERN PLASTICS, listing a variety of flame-resistant materials. We thought this was a very timely article in view of the recent interest in flame-resistant materials generated by the Underwriters Laboratories' changed attitude.

We regret that data on cellulose acetate sheeting, some of which is self-extinguishing, was not included and hope that if and when this table is revised or another similar article written, we will have an opportunity of including these products in the presentation.

W. D. Paist, Technical Advisor
Market Development Dept.

Celanese Plastics Co.
Newark, N. J.

See page 92.—Ed.

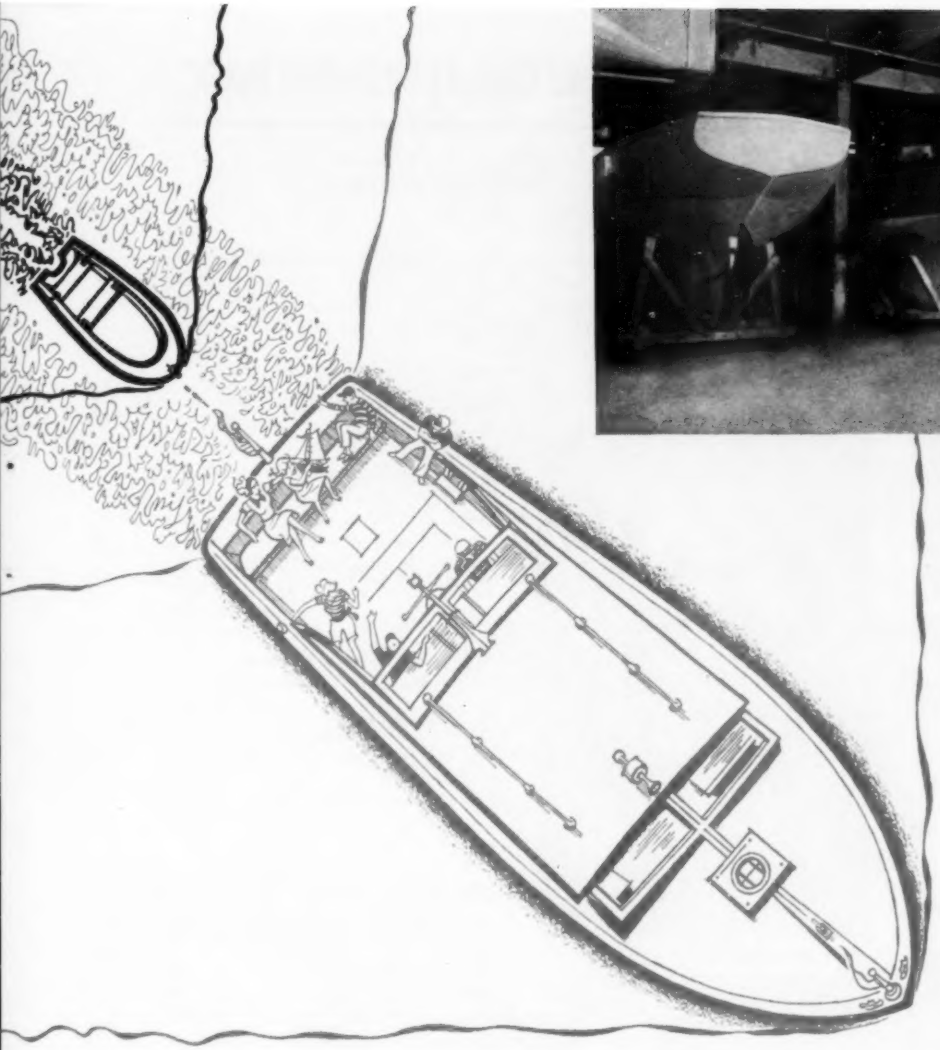
Both are right

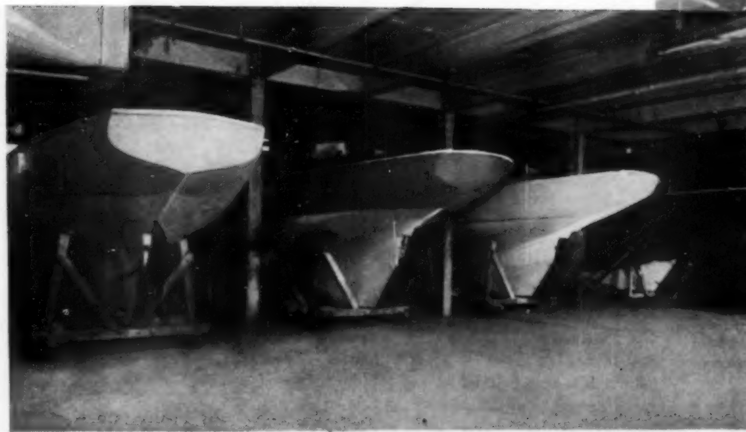
Sir: In studying the January, 1960, issue of MODERN PLASTICS, I happened to compare your data for estimated consumption of polyethylene by end-uses with the data published by the U. S. Tariff Commission. In 1958 MODERN PLASTICS shows 245 million lb. of material going into film and sheeting. The Tariff Commission reported 315 million lb. for this end use. Undoubtedly your publication has very good reasons for differing with the Tariff Commission's data. Will you please explain your thinking in this area to me?

John Poindexter,
Marketing Research

Phillips Chemical Co.
Bartlesville, Okla.

The government figures in 1958 included figures for resin used for film, sheeting, and coating in the United States, as well as part of the film resin that was exported. The 1959 figures included resin for film, sheeting, and coating; but resin for export is now reported in Miscellaneous. Our figures included only film and sheeting. Coatings are shown under that category. Exports appear under Miscellaneous.—Ed.





Production line at Pearson Corporation, Bristol, Rhode Island

BIG OR SMALL MAKE THEM ALL BETTER WITH Celanese POLYESTER RESINS

TRITON sloop or yawl, made by Pearson with Celanese MR Resins

For reinforced plastic boat fabrication, Celanese offers a series of thixotropic resins which exhibit superior resistance to drainage even on vertical surfaces. They can easily be applied to reinforcing materials by brush, squeegee, roller or spray. Celanese polyesters give you excellent wetting of the glass reinforcement and fast, uniform cure cycles for economical production. Celanese specially formulated gel coats give a tough, resilient surface characterized by a mirror-like finish. ■ Solve your boat production problems with Celanese "MR" polyester resins. Make smooth impact-resistant hulls by hand lay-up, spray gun, pressure bag or matched die methods. Suitable resins are available for every manufacturing process. ■ To assist you with any problem concerning polyester resins, Celanese maintains a Technical Service and Applications Laboratory. Be sure to take avantage of this service. Or, for technical data on Celanese polyesters, write to: Celanese Plastics Company, a Division of Celanese Corporation of America, Dept. 201-D, 744 Broad Street, Newark 2, N. J.

Celanese® MR®

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver.
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Ave., New York 16, N. Y.

NEW MACHINERY-EQUIPMENT

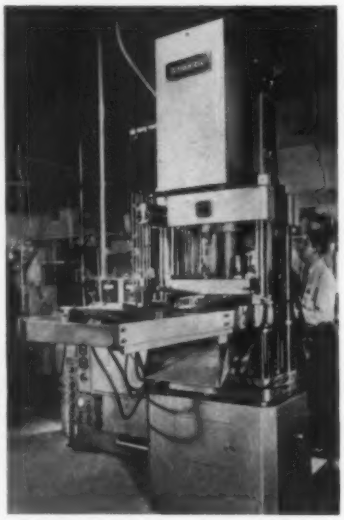
Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Transfer presses

This series of fully automatic hydraulic transfer presses includes the Model 741, in 50-ton, 75-ton, and 150-ton capacities, and the Model 743, a 300-ton unit. The presses can be operated fully-automatically, intermittently, manually, or semi-automatically. Clamping ram pressures and the transfer ram are independently controlled, and can be precisely adjusted up to full capacity. The presses have high-speed low-pressure closing, followed by a slower-speed high-pressure final clamp and a fast transfer. Both models have built-in preform preheaters and automatic feeders. The automatic feeder system uses a vibratory bowl to feed the preheater, and a conveyor to carry the heated preforms into the mold. This integration makes the press completely automatic. Two safety provisions are designed into each of the transfer presses.

First, automatic detection of short shots or overcharging will immediately interrupt the press cycle. Second, automatic detection of an incompletely-closed mold, will prevent the actuation of the transfer ram, preventing flashing. Full specifications appear in the accompanying table. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.



STOKES Model 741 fully-automatic transfer press showing a 150-ton unit.

Specifications: Stokes automatic transfer molding presses

	Model 741[a]		Model 743
Clamp capacity, tons	75	150	300
Clamp stroke, in.	12	14	12
Daylight press open, in.	28	32	26 by 34[b]
Daylight press closed, in.	16	18	
Platen area, L-R by F-B, in.	15 by 13	24 by 20	23½ by 16
Clamp ram speed, in./min.:			
Closing	300	400	
Intermediate	140	72	
Pressing (adjustable)	0-27	0-22	
Opening	300	400	
Ejection stroke, in.:			
Top ejection	2½	3	4½
Bottom ejection	3⅞	4⅞	
Ejection pressure, tons:			
Top ejection	3	5	15
Bottom ejection	5	12	
Bottom transfer capacity	19	30	70
Bottom transfer stroke, in.	8	10	12
Bottom transfer speeds, in./min.:			
Advance	450	360	150
Pressing (adjustable, except 150-ton)	0-100	100	0-65
Return	450	300	150

[a] 50-ton is identical to 75-ton, except for pressures. [b] Adjustable.

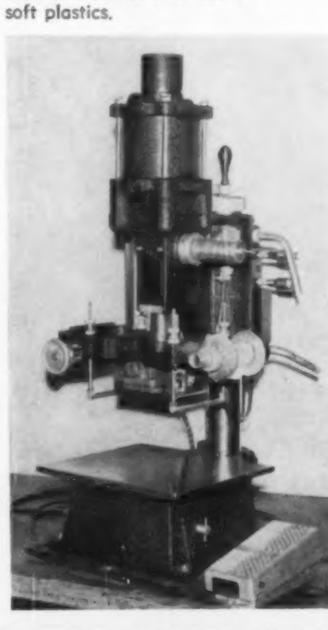
Thermocouple glands

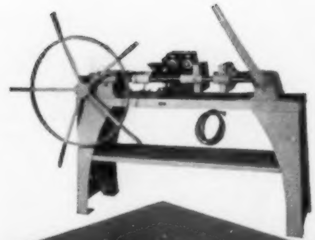
For pressure sealing two or four 20- or 24-gage bare wire thermocouples, a new, complete 8-model line midget thermocouple glands can be used on plastic heating equipment where space is a problem. The stainless steel glands are only 1¼ in. long by $\frac{9}{16}$ in. hex—an unusually small unit for providing a positive seal for wires at vacuums of 0.005 microns to pressures of 5000 p.s.i. Operating temperature range of the midget thermocouple glands is —300 to 1850° F. This fitting can be furnished from stock with or without thermocouple wires and can be used and reused by simply replacing ceramic insulators and sealant. *Conax Corp., 2300 Walden Ave., Buffalo 25, N. Y.*

Hot stamp press

Model A.B.P. bench press is air-operated and has a built-in air cylinder which is cushioned at both ends to avoid hammer blows on the work. A micrometer screw is provided for the adjustment of the impression, as is a timing relay to control dwell. Standard (To page 50)

PEERLESS Model A.B.P. bench press will hot-stamp up to 4¼ in. wide (width of foil) on both hard as well as soft plastics.





FROM 1946

14 years ago, Van Dorn produced this hand-operated press. It was specifically designed for experimental work, training schools and laboratories. Many of these rugged units are still in service throughout the world.

Progress in Plastics by VAN DORN

Satisfied users of early Van Dorn machines have steadily asked for larger units. Van Dorn's progress is now climaxed by this fully automatic 4-6 oz. Model 400. It plasticizes 100 pounds plus per hour, has 175-tons clamping pressure and achieves up to 840 dry cycles per hour.

TO 1960

Established in 1872, Van Dorn has steadily expanded its facilities and diversified over the years. Entering the plastic machinery field after World War II with the simple press shown above, Van Dorn now has an extensive line of ultra-modern, fully automatic plastic injection machines.

Besides producing top quality presses, Van Dorn offers the plastic industry these plus benefits:

PROMPT SPARE PARTS SERVICE

Maintaining a complete inventory of spare parts, Van Dorn is geared to facilitate your needs by prompt attention and quick shipment.

DEMONSTRATION DEPARTMENT

We maintain a complete battery of presses—Models H-400, H-300, and H-260 in our Cleveland factory, to show you exactly how Van Dorns will perform on your jobs. Without obligation, send us your mold for an actual free demonstration of the results you can obtain in your plant.

PACKAGE SERVICE

If desired, Van Dorn will assist in procuring a well designed mold from a competent moldmaker for your parts. Then Van Dorn will check the operation of the finished mold in our factory. There is no charge for this unique service.

Write for Detailed Information on Van Dorn Presses.

Van Dorn

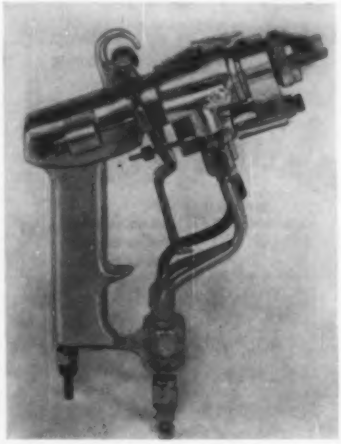
THE VAN DORN IRON WORKS CO. • 2685 EAST 79TH STREET • CLEVELAND 4, OHIO

(From page 48)

press comes with foot pedal control but is also available with hand controls. Speed adjusts up to 40 impressions/minute. Automatic side-to-side roll feed is adjustable up to 5 in. of leaf 4¼ in. wide. Pilot light and thermometer are included in automatic heat control circuit. Maximum opening from 12 by 11 in. stationary table to die plate is 5 inches. Die plate size 4 by 5 inches. Press stroke is two inches. Unit requires 2 hp., 80 p.s.i. supply of air and 110 v. A.C. *Peerless Roll Leaf Co. Inc., 4511 New York Ave., Union City, N. J.*

Spray gun and feed tanks

Suitable for handling two component systems in resin or foam spray coating applications, the Turbulator gun uses a tapered roller bearing for positive internal mixing. The gun is designed to handle viscosities from 1 to over 100,000 cp. at rates up to 10 lb./minute. Spray is adjustable to provide cone or a fan shaped pattern. An air supply of 80 p.s.i. at 30 cu. ft./min. is required. The gun, with nozzle removed, can also be used as a pouring spout and will deliver a 1¼-in. diameter fluid stream under gravity or 25 p.s.i. injection pressure. The gun weighs 4.5 lb. (less hose and couplings), air and fluid valves are operated from a single trigger, and cleaning is accomplished by flushing the gun with solvent through the catalyst side. The spray unit is used with the Formulator, a position displacement proportioning machine which automatically controls the volume rate delivery of the fluid streams to an accuracy of ±1%, and can handle resins with viscosities up to 3000 cp. at temperatures up to 210 ±10° F. Operating capacity on foams is 0 to 6 lb./minute. The unit requires 30 cu. ft./min. of air at 80 to 100 p.s.i. for spray jobs and 20 cu. ft./min. at 50 p.s.i. for pouring jobs. Base price of gun and formulator: $8700 with 4 to 6 weeks deliveries. *Binks Mfg. Co., 3114-44 Carroll Ave., Chicago 12, Ill.*



BINKS Turbulator 2-component Spray Gun positively mixes components within the gun rather than mixing spray streams externally.

Vacuum conveyor

Designed for dust-free handling of free-flowing powdered or granular plastics and other materials, the Model 400 vacuum conveyor can move over 1200 lb./hr. A sealed auxiliary hopper, suspended *over* the press hopper, traps dusty materials in a vacuum. The vacuum is automatically released when the smaller hopper is filled. The material then flows through a soft shroud into the press hopper. Departing from the usual design, this conveyor has its own power and control unit placed on the floor, which makes for simplified installation and access to the hopper for clean- (To page 52)

NEW MACHINERY-EQUIPMENT

(*From page 50*)

ing prior to material changes and replacement of the filter or shroud when necessary. A "blow-back" feature forces air back through the filter after each loading cycle. This cleans the filter of dust and gives the filter longer effective life. A telescoping pick-up tube is provided to speed drum placement and changing. The vacuum conveyor is supplied for 60-cycle single- or three-phase 220 v., or 440-v. 3-phase power operation. Special electrical requirements can be met on request. No plant air supply is needed. *Whitlock Associates Inc., 21655 Coolidge Highway, Oak Park 37, Mich.*

WHITLOCK Vacuum Conveyor Model 400 has its own air and vacuum system; requires no auxiliary air supply.

Vacuum hopper

The NRM Universal Vacuum Feed Hopper removes air and volatiles from powdered or granular plastic materials that otherwise would require prolonged drying before being fed to the extruder. It will also remove moisture from pre-heated materials. Bubble-free extrusions without faults due to occluded air result. The feed hopper is designed for installation on NRM 2½ through 4½ in.; special hoppers for larger extruders are available on request. A seal is required in the extruder between the cylinder barrel and the screw bearing section to minimize air leakage and maintain vacuum in the sealed section of the extruders. Included in the equipment is a heavy duty air-operated feed valve, and a level control system which provides automatic or manual control of the feed. When the feed valve opens during operation, vacuum pulls material from either a material bin or hopper drier. The table shows the vacuum required for various extruder sizes.

Extruder size, in.	*Vacuum Req'd at 26 in. of Hg. cu. ft./min.*[a]
2½	30
3½	50
4½	80-100

[a] Model 50 to 55 NRM extruders.

For results obtainable with this equipment see "Vacuum Hopper Extrusion," on p. 105 of this issue. *National Rubber Machinery Co., 47 W. Exchange St., Akron 8, Ohio.*

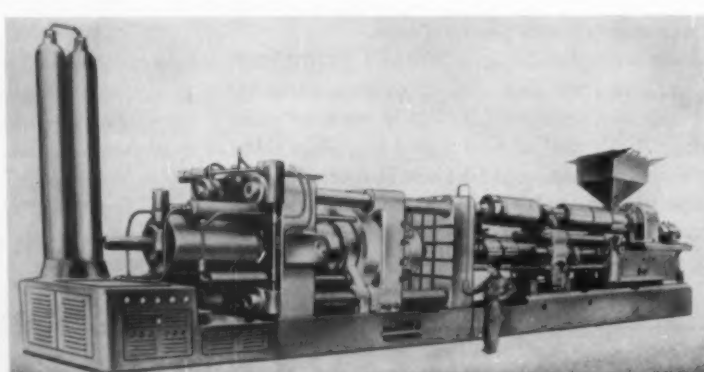
Injection press

Called the Preplastmatic 20/400/3000 this oil-operated, self-contained, automatic injection molding machine has an injection capacity of 44 lb., is equipped with a screw preplasticator, and will plasticate up to 880 lb. of material per hour. Platen stroke is about 78 in. (200 cm.) and clamping force is 3000 tons, using a locked piston system. Maximum daylight between the open platens is about 148 in. (375 cm.). Molds ranging in thickness from 39½ in. (100 cm.) to 69 in. (175 cm.) can be accommodated. Nominal platen dimensions are 86½ by 98½ in. (220 by 250 cm.). The press uses Vickers hydraulic equipment and the electrical circuitry is by Siemens. *A. Triulzi, Via Vialba 56, Novate, Milan, Italy.*

Impulse sealer

A line of thermal impulse sealers for plastic film and sheet, called Weldotron Sealmasters, is of simple design and priced to sell in the range of ordinary hot bar sealers. The rapid heating and cooling cycle for optimum film sealing is achieved by pulsing a thin ribbon of high temperature alloy with a high current for a short time interval. After the heating current is cut off, the extremely low thermal capacity of the alloy ribbon results in an effective reversal of heat flow and a resultant rapid cooling action. Though designed for PE sealing, units work equally well (To page 54)

WELDOTRON SEALMASTER. This bench-mounting model is foot-pedal operated.



TRIULZI Preplastmatic 20/400/3000 injection press will deliver a 705 oz. injection shot.

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16577 Meyers Road
Diamond 1-3454

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"It was the Quinn-Berry Crystal which enabled us to design the new Lathem Time Recorder to give it unprecedented beauty.

"For example, we were able to get a curved Quinn-Berry Crystal which would easily mount in the case of the Lathem Recorder without the need of a bezel. This allowed us to design the recorder so that the face is flush to the clock case, and stands out even more, because of the effect of the curved crystal.

"In addition, this crystal causes no distortion of the face numerals, is unbreakable, resists scratches and discoloration, and does not rattle . . .

"All of us at the factory, as well as our Lathem dealers, have praised the modern appearance of the new Lathem Recorder which owes so much of its design to the qualties of the Quinn-Berry Crystal."

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CUSTOM MOLDERS OF ALL TYPES OF THERMOPLASTICS

NEW MACHINERY-EQUIPMENT

(From page 52)

on other films such as saran and vinyl. Available in a wide variety of sizes. *Plastic Welding Corp., 841 Frelinghuysen Ave., Newark 12, N. J.*

Insert injection press

The Model 12 Duplimatic 4- to 6-oz. injection machine is designed for the production of plastic parts requiring inserts such as electrical cord plugs, condensers, etc., and can also be used for second color molding. The elimination of the center tie-bar provides the operator unobstructed access to the mold cavities. An extended two-station shifting table puts the loading stations completely outboard of the C frame clamp assembly. It incorporates a hydraulic slowdown device, cushioning the table travel at both ends of the stroke, for quieter, smoother operation with reduced wear. A simplified part ejector system allows greater flexibility in mold design and increased variations in cavity sizes. The new machine cycle sequence is particularly adapted to insert molding. Specifications for the machine appear in the table below. *Moslo Machinery Co., 2443 Prospect Ave., Cleveland 15, Ohio.*

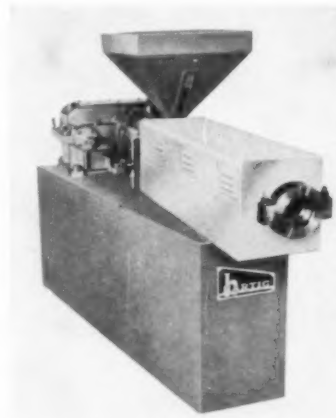
MOSLO Model 12 Duplimatic, 4-6 oz. injection molding machine for insert work, is equipped with beryllium copper cylinder and tubular cylinder heaters.

Grinding mill

For the production of pulverized, finely divided PVC, polyethylene, and other thermoplastic powders, the Pallmann Turbo-Mill, an impact type mill, incorporates a rotating impeller that flings the feed material against a counter-rotating, mating, plate-shaped cone. The cone is grooved and made of hardened steel so that the impinging material disintegrates on impact. By adjusting the gap between the rotating parts and a stationary baffle plate, mounted facing the rotating parts, the degree of beating can be regulated closely. No screens are needed and since no cutting is involved the dulling of blades is not a factor in maintenance. The unit can be supplied with water cooling to minimize mechanical heat build up. Output rates will depend on the material to be pulverized. Two motors are required to drive each of the counter-rotating parts. Four size models are available: PP4, PP6, PP8 and PP12. Also available are the auxiliary units that make up a complete pulverizing system. *The Rainville Co. Inc., 657 Franklin Ave., Garden City, N. Y.*

Extruder

Developed to meet the needs of the newest plastic materials and incorporating test extrusion technology, Trapezoidal series of heavy-duty and high-capacity extruders has high-screw speeds with maximum power input and develop high extrusion pressures. New balanced-design herringbone gear reducer has been especially designed for this line. Increased thrust bearing capacity, internal lubrication, higher thermal ratings and elimination of auxiliary cooling result. The thrust housing accommodates interchangeable bearings to alter the extruder to fit the job. The extruder also contains an air or mist cooling system which can be used with or in place of the Hartig cooling coil system. Alternate types of barrel heaters and controls are provided to suit the application. Improved auxiliaries such as quick-change breaker plate, pressure regulating valves, clamp ring and dies are provided as accessories. The new line will be available in 2½-, 3½-, 4½-, and 6-in. screw sizes. Hartig will continue to make the present "standard" series in addition to the new series. *Waldron-Hartig Div., Midland-Ross Corp., 1137 Globe Ave., New Brunswick, N. J.*



HARTIG Trapezoidal extruder gets its name from the shape of its base which makes for easier maintenance and cleaning.

Correction

"New Machinery & Equipment," MPl, Feb. 1960, p. 52: *Mold wiper.* Unit is made in four sizes giving maximum strokes of 12, 15, 18, and 24 in. and minimum strokes ⅔ of maximum. Blade action is air operated and requires minimum of 50 p.s.i. Device is normally mounted on stationary mold half and can be adapted for use with any injection molding machine. Price of 12-in. unit is $250. Manufacturer of the wiper is Bermer Tool & Die Inc., Southbridge, Mass.—**End**

Specifications: Model 12 Duplimatic

Plasticating capacity, lb./hr.	70.
Dry cycles/hr.	690.
Injection rate (with booster), cu. in./sec.	9.36
Injection stroke, in.	8.
Mold size, top half, in.	8 by 10 by 5 thick
bottom half, in.	8 by 23½ by 5
Mold shift stroke, in.	13½
Max. mold casting area, sq. in.	40
Clamping (calc.), tons	90
Cylinder temp. range, °F.	150 to 650

WORLD-WIDE PLASTICS DIGEST*

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Plastics. E. L. Kropa and E. E. McSweeney. Ind. Eng. Chem. *52,* 42A-49A (Jan. 1960). Developments in plastics materials during 1959 are briefly reviewed.

Materials

Plastics foams. C. R. Davall. SPE J. *15,* 955-56 (Nov. 1959). Several types of plastics foams are briefly described according to their advantages and disadvantages, preparation, uses, and forms in which they are supplied. The materials include phenolics, polystyrene, vinyls, polyethylene, and epoxies, as well as cellulose acetate.

Preparation, molding and dielectric properties of poly-N-vinylcarbazole. H. Davidge. J. Appl. Chem. *9,* 553-60 (Oct. 1959). Bulk polymerized N-vinylcarbazole forms a hard machinable material while suspension polymerization material is used to form a molding compound or foamed plastic. This polymer is comparable to polystyrene (PS), having a dielectric constant of 3.00 and power factor of 0.001 over a wide frequency range, but is more stable to changes of frequency and temperature. Mechanically, poly-N-vinylcarbazole is slightly inferior to PS but has superior thermal stability. Maximum operating temperature appears to be in the range 150-200° C.

Condensation polymers from diisocyanates and dioximes. T. W. Campbell, V. S. Foldi, and R. G. Parrish. J. Appl. Polymer Sci. *2,* 81-85 (July-Aug. 1959). Diisocyanates condense readily with the two active hydrogen atoms in dioximes to give high molecular weight linear condensation polymers. In several cases these polymers, such as the one from cyclohexanedione dioxime and 4,4'-biphenylene diisocyanate, may be converted to tough films or fibers. Thermal, hydrolytic, and light stability of these polymers were in general poor.

Synthesis, polymerization, and copolymerization of esters of vinylphosphinic acid. H. S. Kolesnikov, E. F. Rodionova, and L. S. Fedorova. Vysokomolekuliarnye Soedineniia *1,* 367-72 (Mar. 1959). The synthesis of esters of vinylphosphinic acid is described, and it is shown that these monomers polymerize on heating in the presence of benzoyl peroxide. The glassy temperature of the polymers synthesized was determined. The esters copolymerize with acrylonitrile, the content of vinylphosphinic ester residues always being lower than that in the initial monomer mixture.

Internally plasticized PVC. H. W. Ebersbach and K. H. Michl. Kunststoffe *49,* 513-16 (Oct. 1959). A series of internally plasticized polyvinyl chloride resins was developed by suspension polymerizing a mixture of monomers. These resins combine excellent mechanical properties with easy processability. Their properties, processing possibilities, and applications are described.

Impact thermoplastics: Which one to use? M. W. Riley. Materials in Design Eng. *50,* 123-38 (Nov. 1959). This article is a manual, comparing impact resistant thermoplastic resins, as a screening guide in the evaluation of available materials. Included in the survey are high and low density polyethylenes, polycarbonates, rigid polyvinyl chloride, polystyrene, cellulosics, acrylonitrile-styrene-butadiene combinations, fluorocarbons, nylon, modified acrylic, polyacetal, and polypropylene. Impact tests are discussed in respect to advantages and limitations, and comparisons of the resins are made. Modulus of elasticity in flexure, ultimate tensile strength, effect of heat and cold, dimensional stability, volume resistivity, and electrical properties, as well as costs of the resins are also compared.

Applications

Laying of PVC floor coverings. R. Frenz and K. Fischer. Kunststoffe *49,* 582-83 (Oct. 1959). A plastic-covered floor is satisfactory only if it has been properly laid. The requirements of the subfloor and technique that is used in laying such floors are discussed.

Rubber and plastics in aircraft and rockets — nonstructural applications. Rubber and Plastics Age *40,* 1079, 1081 (Oct. 1959). Nonstructural applications of rubbers and plastics in aircraft and rockets, such as encapsulating compounds, electrical insulation, printed circuits, and thermal insulation, are described.

Flat reinforced-plastic springs. L. A. Heggernes. Prod. Eng. *30,* 74-76 (Nov. 9, 1959). Glass-reinforced plastics are excellent energy absorbers and are receiving attention in spring design. An epoxy cantilever beam can be molded with up to 87% of its fibers in the bending direction to produce a leaf spring that is twice as efficient as a steel spring of equal thickness. This is accomplished by using pre-impregnated glass rovings. Details of spring design are given.

Applications of epoxy resin-based coatings in corrosive environments. H. Brull. Corrosion Tech. *6,* 303-06 (Oct. 1959). A survey of the use of epoxy resin-based coatings in anti-corrosion applications is presented. Areas of primary use are in storage tanks, pipelines, nuclear power stations, aircraft, and concrete coatings. Methods of modifying the epoxy with coal tar components, drying oils, or alkyds for special coatings are discussed.

Plastics in the auto industry. SPE J. *15,* 968-73 (Nov. 1959). The present status of plastics now in use in the auto industry is surveyed in a series of short articles.

Properties

Oriented thermoplastic sheet and film. C. P. Fortner and P. Dalton. Materials in Design Eng. *50,* 94-99 (Dec. 1959). The properties and design characteristics of uniaxially and biaxially oriented thermoplastics are discussed. Orientation of polystyrene and styrene-acrylonitrile copolymers greatly improves tensile, compressive, flexural, and impact strengths and aging resistance. Similar improvements occur with polymethyl methacrylate. Polyethylene is sensitive to the degree of orientation and orientation temperature. Dimensional stability is decreased as a result of orientation. In the case of polypropylene tensile strength is increased, but strengths in the longitudinal and transverse directions are not balanced. The "trapped sheet process," in which stretching stresses are **(To page 58)**

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Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

**REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N. Y.**

PLASTICS DIGEST

(From page 56)

being relieved as the sheet approaches forming temperatures, has several advantages over vacuum forming for biaxially oriented sheets.

Physics of adhesion. N. A. De Bruyne. Plastics Inst. Trans. & J. 27, 140-46 (Oct. 1959). Some of the reasons for the measured strength values of adhesive-bonds being much less than those predicted by interfacial forces are 1) cohesive failure, 2) incomplete contact, 3) residual stress, 4) concentration of applied load, and 5) steric hindrances on an atomic scale. The first four reasons are discussed in detail.

Tertiary amine catalysts. How they affect foam properties. G. T. Gmitter, E. E. Gruber, and R. D. Joseph. SPE J. 15, 957-60 (Nov. 1959). A large number of tertiary amine catalysts were evaluated through their effect on variations in properties of a polyester urethane foam of the polydiethylene glycol adipate-TDI type. The catalysts grouped according to common structural characteristics, consisted of trialkyl tertiary amines, beta-amino ethoxy amines, and morpholine derivatives. Physical properties of the foams produced with these catalysts show that the nature of the amine plays an extremely important role in the final product.

Wettability of perfluorocarbon polymer films: Effect of roughness. A. J. G. Allan and R. Roberts. J. Polymer Sci. 39, 1-8 (Sept. 1959). The wettability of various perfluorocarbon polymer surfaces was studied by observing the advancing and receding contact angles formed by a drop of liquid on the surface. Differences in hysteresis can be given a reasonable interpretation in terms of surface topography. The variation in roughness changes the advancing contact angle by as much as 30° and the advancing-receding hysteresis varies from 13 to 59°. The receding angle is probably the more important in adhesion of ice where drops are blown across the surface at glancing angles. Exceedingly smooth perfluorocarbon polymer surfaces may be better than rougher surfaces for resisting the adhesion of ice.

Problems relating to the standardization of polyester molding compounds. A. Rost. Kunststoffe 49, 459-60 (Sept. 1959). In preparatory work by manufacturers and users of polyester molding compounds on the standardization of these materials it was found that experimental results vary more than is the case with similar tests on phenolic and urea compounds. Uniformity in test pieces is of vital importance. The solution to this problem is found in the recently issued German Draft Standard DIN 16911, which deals with polyester molding materials.

Weathering resistance of plasticized PVC compounds for cables and electrical engineering. W. Birnthaler and G. Falk. Kunststoffe 49, 439-46 (Sept. 1959). Samples of plasticized polyvinyl chloride sheet were exposed to natural weathering over a period of 8 years. Resultant embrittlement was investigated mainly by the sensitive low temperature impact strength. The extent to which individual components influence the effects of weathering is shown. By suitable compounding, a PVC compound can be obtained that meets all practical requirements.

Spreading of liquids on polyethylene film. The effect of preprinting treatments. A. J. G. Allan. J. Polymer Sci. 38, 297-306 (Aug. 1959). A study was made of the wettability of thin films of polyethylene by observing the equilibrium advancing contact angle formed by a drop of liquid on the surface. Treatment of polyethylene film by exposure to methane/oxygen flames of varying intensity produces a controllable increase in the polarity of the surface as measured by the contact angles with a series of solutions of ethyl alcohol in water. The surface tension lowering of water by ethyl alcohol required to give complete spreading was determined for each flaming condition and related to the adhesion of a polar printing ink. It is shown that an essential criterion for good ink adhesion is the complete wetting of the film surface by the ink. It is suggested that a simple measure of the efficacy of the preprinting treatment would be the contact angle of water with the film.

Gaseous combustion products from plastics. E. H. Coleman. Plastics (London) 24, 416-18 (Oct. 1959). A literature review was conducted to collect information on the various types of gaseous combustion products evolved from plastics materials in the presence of copious supplies of oxygen. In the majority of fires involving large amount of plastics, the primary hazard is the presence of carbon monoxide and copious amounts of smoke, particularly in the case of chlorinated plastics. Very small amounts of other more lethal gases may act as irritants, but the total hazard is similar to that encountered in normal fires, with the exception of excess smoke.

Testing

Control of thermal history of polyethylene test specimens. A. M. Birks and A. Rudin. ASTM Bull. No. 242, 63-67 (Dec. 1959). The effects of thermal history of polyethylene on the properties of test specimens of this material were studied. The thermal history of any polyethylene molding effects its mechanical properties to a considerable and, at present, unpredictable extent. The rate at which a polyethylene molding has been cooled from the melt is the major factor. Variations in rate of cooling can create effects very much greater than those due to changes in melt index, density, etc. Very rapid cooling has a beneficial effect on the results of all tests involving propagation of a crack through the specimens. The conditioning method that is described provides uniform test specimens suitable for the comparison of different polyethylenes.

Analysis of polyester resins by infrared spectroscopy. R. J. Grisenthwaite. Brit. Plastics 32, 428-29 (Sept. 1959). A new technique in qualitative infra-red analysis of polyester resins was developed. Analysis is based on the use of styrene solutions of the uncured resins as capillary films between sodium chloride plates, as mulls in paraffin, or as films deposited on the plates from ethyl acetate or acetone solutions. Most of the major components used in these resins can be identified by characteristic absorption bands. Unreacted maleic anhydride can occasionally be identified, but since this acid is isomerized to fumaric acid during polyesterification, only the latter material is normally found. Among the other components which can be detected are adipidic; ortho-, iso-, and tere-phthalic; chlorendic; carbic; and tetrachlorophthalic acids; propylene, diethylene, and ethylene glycols; triallyl cyanurate; and methyl methacrylate.

Torsion pendulum method for determining crystallinity and void content of TFE resins. N. G. McCrum. ASTM Bull. No. 242, 80-82 (Dec. 1959). The properties of arti- **(To page 162)**

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Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

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Dimethylstyrene polymers. L. H. Schwartzman and B. B. Corson (to Koppers). 2,913,440.

Preparation of methyl alpha-chloroacrylate polymer. H. D. Anspon and F. E. Pschorr (to General Aniline). 2,913,441.

Polymerization of propylene. A. S. Matlack (to Hercules). 2,913,442.

Polymerization of diolefins. J. T. Edmonds Jr. (to Phillips). 2,913,443.

High molecular weight polyethylene. E. J. Hotheim and S. Sommer (to Hercules). 2,913,447.

Heat-treated polymers. D. C. Tabler (to Phillips). 2,913,448.

Halogenated polymers. F. D. Hoerger and H. W. Smeal (to Dow). 2,913,-449.

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Thermosetting aminoplasts. W. Metzger and H. Meis (to Rutgerswerke). 2,914,504.

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Water-soluble polyethylene glycol polyesters. H. C. Woodruff (to General Electric). 2,914,509.

Polyelectrolytes. L. L. Contois Jr. (to Monsanto). 2,914,510.

Copolymers of quinodimethanes and sulfur dioxide. L. A. Errede, B. F. Landrum, and H. R. Davis (to 3M). 2,914,511.

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Phenolic resins. J. E. Wilson and R. K. Walton (to Union Carbide). 2,915,492.

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Elastomers. W. J. Snodden (to 3M). 2,915,494.

Dichlorobutadiene polymers. G. S. Stamatoff (to Du Pont). 2,915,495.

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Copolymers of bisphenols and dialkenylspirobi-(m-dioxanes). J. E. Wilson and R. K. Walton (to Union Carbide). 2,915,499-500-1.

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Polyamides. J. R. Caldwell and R. Gilkey (to Eastman Kodak). 2,916,476.

Hydrolyzing polyacrylonitrile. J. B. Ott (to Monsanto). 2,916,477.

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Polymers of 3,4-epoxycyclohexylmethyl 3,4-epoxycyclohexanecarboxylates. B. Phillips, F. C. Frostick Jr., C. W. McGary Jr., and C. T. Patrick Jr. (to Union Carbide) 2,917,469.

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Polyvinyl chloride. W. F. Smith (to Imperial Chemical). 2,917,472.

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U.S. Pats., Dec. 22, 1959

Epoxy resins. B. Phillips, P. S. Starcher, C. W. Mc- **(To page 165)**

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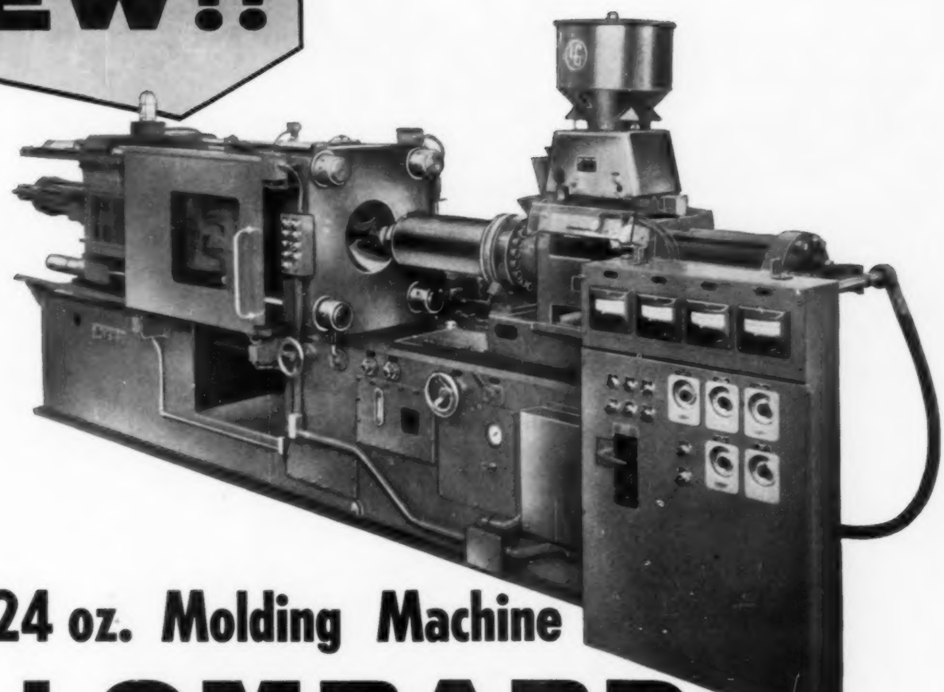

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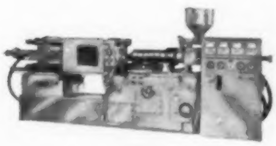

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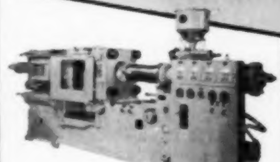

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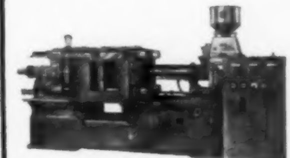

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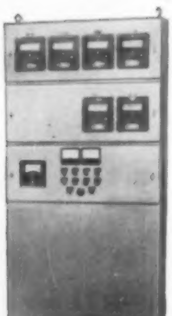

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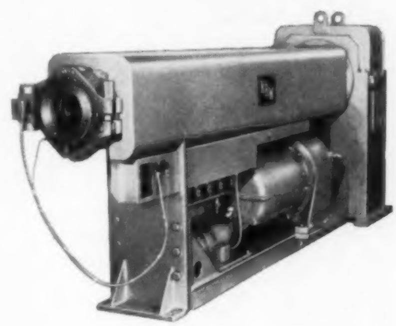

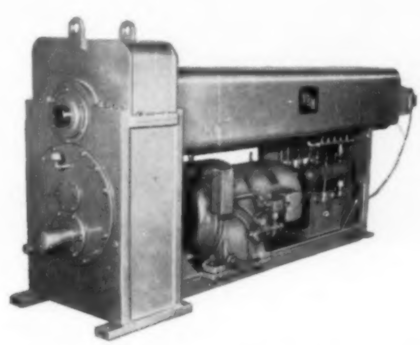

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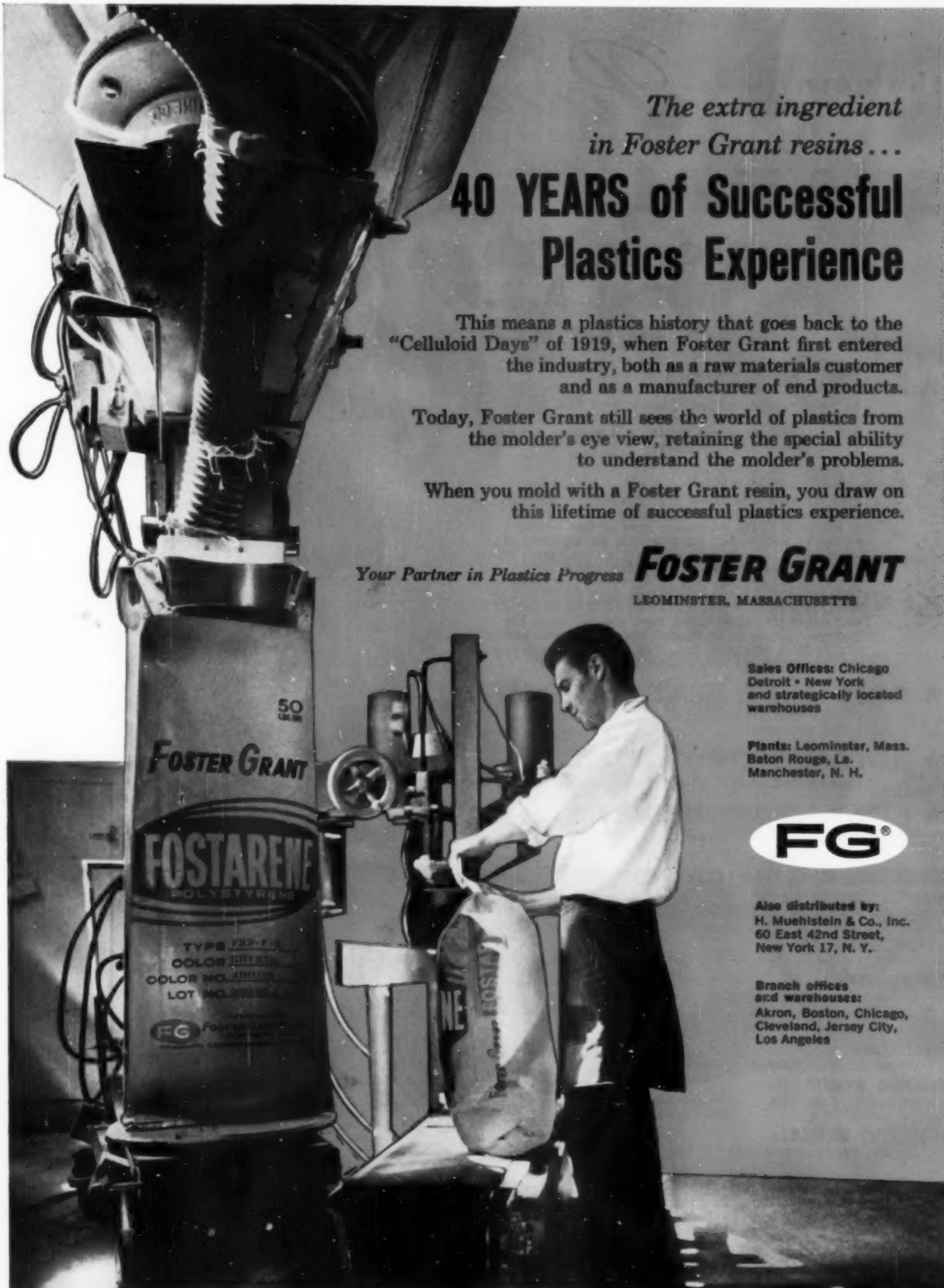

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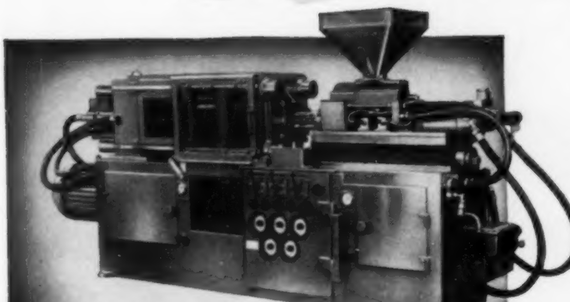

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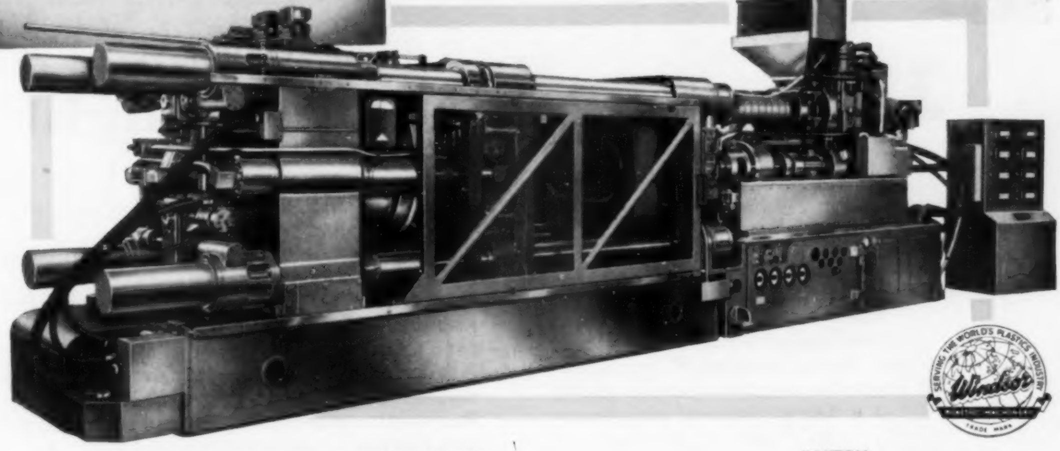

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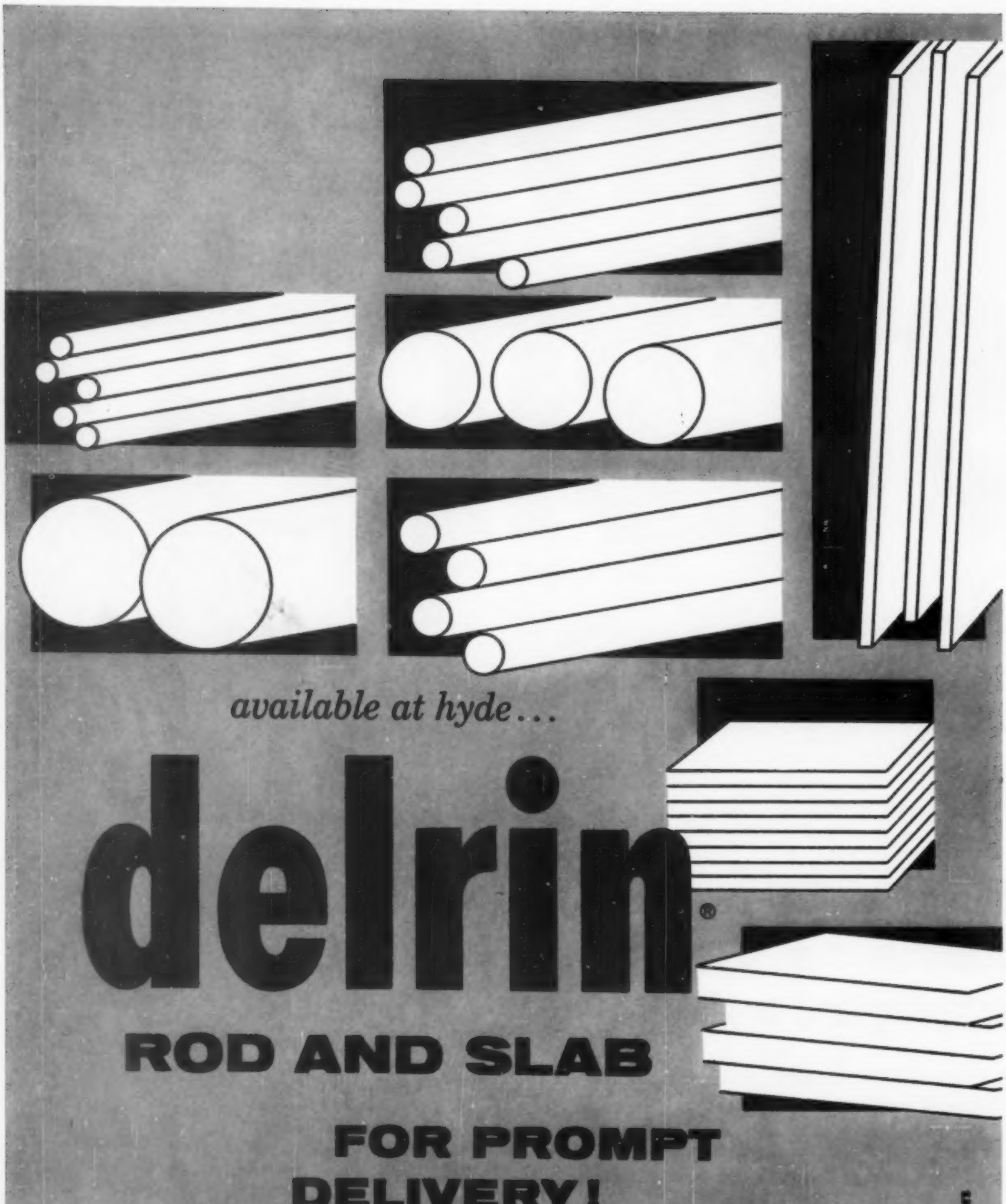
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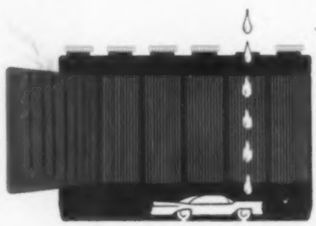

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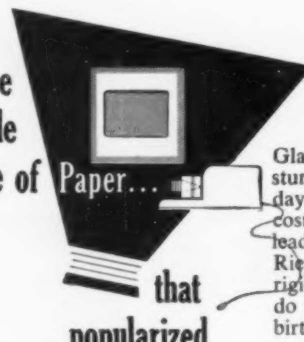

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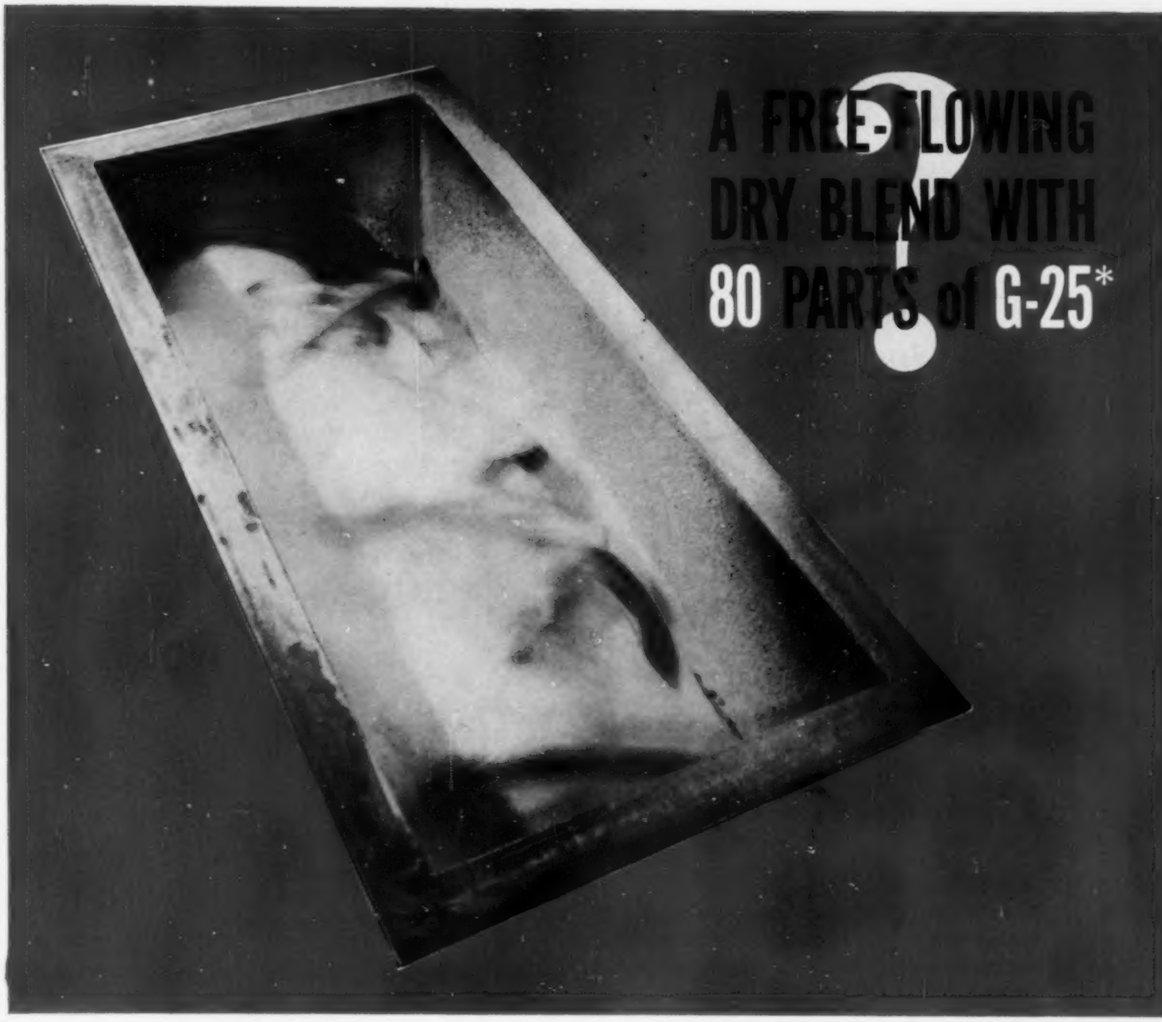

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COLORANTS FOR PLASTICS

April 1960, Volume 37, Number 8

MODERN PLASTICS

HOW to CHOOSE the CORRECT COLORANT

Making the proper choice can mean money in your pocket. Here's a guide through the pigment maze, showing both the shortcuts and the pitfalls

Manufacturers and end-users have always been aware that color in plastics means dollars and cents in terms of the intangible "visual appeal" that moves goods off the shelves.

But now the processors and compounders whose job it is to *put* the color *into* plastics seem to have become just as sensitive to the fact that choosing the right colorants and coloring techniques can also be translated into dollars and cents by virtue of expediting production and satisfying the customer.

In both cases, the best way to achieve this commercial and economic success is to: 1) know the coloring industry and how it services the plastics industry; and 2) know the advantages and limitations of available colors, colorants, and coloring techniques.

Through the labyrinth

At the top of the color ladder are the suppliers of the three basic colorants used by the plastics industry: organic pigments, inorganic pigments, and organic dyes. In a miscellaneous category are the metallic, pearlescent, phosphorescent, and fluorescent pigments that used to be lumped under the over-all head of "special effects." However, the emergence of metallic and pearlescent effects as virtually staple styling for floor tile and upholstery has pushed these materials from the novelty class into big business. Fluorescent pigments added

PIGMENT TYPE	SHADES	RESISTANCE TO:†	Light							OTHER PROPERTIES:																			
		Bleed	Heat	Masstone	Tint	Acid	Alkali	Oxidation	Reduction	Brightness	Opacity tint	Strength	Degree of economy	Molding phenolic	Casting phenolic	Aminos	Polyester	Polyurethane	Nylon	L-D Polyethylene	H-D Polyethylene, Polypropylene	PVC	Acrylic	Polystyrene	Cellulosics	Fluorocarbons	Silicones	Epoxy	Polycarbonate
VIOLETS, MAROONS AND REDS																													
Cadmium sulfo-selenide[1]	Maroon to light red	V	V	V	V	M	V	H	H	M	H	L	X			5†	4	5	5	5	5	5	5	5	5	3	5	5	
Quinacridone	Maroon to medium red	V	V	V	V	V	V	H	H	H	X	M	L			5	5	5	0	5	5	5	0	3	4	3		5	
Para reds	Light red	L	L	H	L	H	H	M	L	H	M	H	H	1	1		2	0	0	0	0	1		1	1	0	0		0
Chlorinated para	Light red	L	L	V	M	V	H	M	L	H	M	H	H	1	1		2	0	0	0	0	1		1	1	0	0		0
Bon (2B-Ca salt)	Maroon to light red	V	MH	M	L	H	M	M	M	V	L	H	M	5	5	5	4	3	1	4	3	5	4	5	4	0	0	4	0
Bon (2B-Mn salt)	Maroon to light red	V	MH	V	H	H	M	M	M	H	L	H	M						1	0	0	3		4	5	0	0	5	0
Lithol rubine	Bluish red	V	M	M	L	H	M	M	L	V	L	H	M	5	5	5	3		1	3		3	4	4	4	0	0	3	0
Ba and Ca lithols	Maroon to light red	H	X	L	X	H	M	M	L	H	M	V	V	0	0	2	3		0	3	0	0	2	2	2	0	0	3	0
Pigment scarlet	Bluish red	H	H	M	L	H	M	M	M	H	L	ML	M	5	5	5	3	5	1	4	4	5	5	5	5	0	0	5	
Madder lake	Red	V	M	V	M	V	H			M	L	M	M						1				4		4	0	0		0
Alizarine maroon	Maroon	V	M	H	M		L	M	M	M	L	M	M						1	4		4	5		4	0	0		0
Helio bordeaux	Maroon	V	H	V	H					M		H	H	4	4	4	3	3	1	4	4	4	4	4	4	0	0		0
Thioindigoid[2]	Maroon	H	M	V	H	V	V	V	L	H	L	H	M	5	5	5	3	5	1	4	4	4	4	4	4	0		4	
Copper maroon	Maroon	V		H	M	V	H			M	M	L								1	1					3			
Toluidine	Maroon to light red	L	H	V	L	V	H	M	L	H	L	H	M	4	4	4	4	0		1	1	0				0	0		
PTA toners	Violet to medium red	L	M	M	X	M	L	M	H	V	L	V	L	4	4	4			0	1	1	0				0	0	3	0
Red lake C	Light red	L	L	L	X			M	L	V	L	H	H	4	4	4	3		0	3	0	2	4	3	3	0	0	2	0
Pyrazolone	Light red	H	M	H	L					H	M	H	L	4	4	4	3	4	0	4		3	4	4	4	0	0	4	0
Napthol	Light red to dark red	H	H	H	M	V	V	H	H	H	L	H	L	4	4	4	3		0	4	0	3	4	4	4	0	0	4	0
Iron oxide	Maroons and brick reds	V	V	V	V	V	V	V	V	X	H	L	V	4	4	4	4	4	5	4	4	3	4	4	4	3	4	5	5
Manganese violet	Violet	V	H	H	H	H			L	H		X	L	4	4	4	3			4	4	3		3		4			
High molecular weight desazo red	Medium to light red	H	V	V	H	V	V	V	L	H	M	H	L			5	5	5	1	5	5	5	5	1	5	0		3	
Vat reds	Medium reds	H	H	V	V	V	V	V	L	H	X	H	L	5	5	5	5		1	5	1	5	5	5	5	0		3	
ORANGES AND YELLOWS																													
Cadmium sulfo-selenide[3]	Orange to very light yellow	V	V	V	V	L	V	H	H	H	H	L	L				4	5	5	5	5	5	5	5	5	5	3	5	
Chrome yellow[4]	Medium to very light yellow	V	M	M	H	H	L	M	L	H	V	L	H	4	4	4	4	1	1	3	1	5	5	4	4	1	0	5	3
Chrome orange[5]	Yellowish to red orange	V	H	H	H	M	M	M	M	M	H	L	M	4	4	4	4	4	1	4	3	4	4	4	4	1	0	4	3
Molybdate orange[6]	Orange and orange-red	V	M	H	H	M	M	M	M	H	H	M	H	4	4	4	5	4	1	4	3	5	5	4	4	1	0	5	3
Vat colors	Oranges and yellows	H	H	V	H	V	V	V	L	H	X	H	X	5	5	5	3	5	5	5	5	5	5	5	5	0		3	5
Benzidine yellow	Light yellow	H	H	V	M	V	H	M	M	H	L	V	M	3	4	4	3		0	5	5	3	4	4	4	0	0	5	1
Benzidine yellow, xylidide	Light to deep yellow	V	H	V	V	V	H	H	M	H	X	V	L	3	4	4	3		1	5	5	4	5	4	5	0	0	5	1
Hansa yellow	Light yellow	L	M	V	V	V	H	M	M	H	L	V	M	5	5	5	3		1	0	0	1	5	4	0	1	0		1
Nickel-azo ("greengold")	Greenish yellow	H	V	V	V	H	H	H	H	M	L	H	L	5	5	5	3	4		5		5	5	5	5	1		5	
Strontium yellow[7]	Very light yellow	V	H	V	H	H	L	M	L	H	H	X	M	5	5	5	3	1	1	4	1	5	5	5	5			5	
Zinc chromate	Light yellow	V	H	H	H	V	L	M	L	M	H	X	L	5	5	5	3	1	1	4	1		5	5	5			5	
Ni-ti yellow[8]	Very light yellow	V	V	V	V	V	V			H	V	X	L	5	5	5	3			5	5	5	5	5	5			5	
Iron oxide	Reddish to yellow tan	V	H	V	V	V	V			X	H	L	V	5	5	5	3	4	3	5	5	3	4	3	4	3	5	5	3
GREENS AND BLUES																													
Phthalocyanine[9]	Blue and green	V	V	V	H	V	V	H	M	V	X	V	M	5	5	5	1	5	5	5	5	5	5	5	5	3		5	5
PTA/PMA toners	Blue and green	L	M	M	X	V	M	L	M	V	X	V	L	4	4	3			0	1	1	1	3	3	3	0	0	3	
Chromium oxide	Dull green	V	V	V	M	V	V	H	H	L	H	L	L	5	5	5	5	5				5	5	5	5	5	5	5	4
Hydrated chromium oxide	Bluish green	V	H	V	M	V	V	H	M	H	X	X	L	5	5	5	5					5	5	5	5		5	5	
Chrome green	Dark bluish to light yellow-green	V	H	M	M	H	L	H	M	L	H	M	H	5	5	5	4	1	0			2	5	5	5			5	
Pigment green B	Dark green	M	M	V	L	H	V			L	M	H	H			1	0	0	0			2		3		0	0	4	5
Iron blue[10]	Dark blue	V	M	V	M	V	L	H	X	L	X	M	V	5	5	5	4	1	0			2	5	5	5			5	
Ultramarine	Blues and violets	V	V	V	L	X	V	H	M	V	L	L	H	5	5	5	5	5	5	5	5	3	5	5	5	3	5	3	5
Indanthrone	Blue	H	V	V	V	V	V	H	L	V	L	V	L	5	5	5	3		1	5	5	5	5	5	4	0		5	
Cobalt blue	Blue	V	V	V	V	V	V	V	V	M	M	X	L	5	5	5			5	5	5	5	5	5	5	5	5	5	5
WHITE																													
Titanium dioxide, rutile	White	V	V	V	V	H	V	H	M	H	V		V	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Titanium dioxide, anatase	White	V	V	V	V	H	V	H	M	V	H		V	5	5	5	4	5		5	5	5	5	5	5	4	5	5	5
Zinc oxide	White	V	H	V	V	M	M	H	M	M	M		H	5	5	5	0		0			0	5	5	5			5	
Antimony oxide[11]	White	V	H	V	V	M	M	H	M	M	M		H	5	5	5	5			5	5	5	5	5	5			5	
BLACKS AND BROWNS																													
Channel	Jet black	V	V	V	V	V	V	H	V		V	V	H	5	5	5	1	3	5	5	5	5	5	5	5	5		5	
Furnace	Black	V	V	V	V	V	V	H	V		V	H	V	5	5	5	1	3	5	5	5	5	5	5	5			5	
Lamp black	Bluish black	V	V	V	V	V	V	H	V		H	M	H	5	5	5	1	5		5	5	5	5	5	5			5	
Iron oxide	Brown and black	V	V	V	V	V	V	H	V		V	L	V	5	5	5	3	5	5	5	5	5	5	5	5	1	1	5	
Bone black	Black	V	V	V	V	L	H	H	V		M	L	M	5	5	5	1	3		5	5	5	5	5	5			5	
SOLUBLE DYES																													
Oil soluble: Azo	Yellow to red (red) green, blue, black, brown	X	L	L	M	L	M	L	H					4	4	0	4	4	2	0	0	3	3	4	3	0	4	3	0
Oil soluble: Anthrequinone		X	H	H	M	M	M	L	H																				
Spirit soluble, condensed azo	Wide range	X	L	H	L	M	M	*	*					0	0	2			2	0	0	3	0	0	4	0	0	0	0
Acetate dyers	Wide range	X	H	H	L	M	M	*	*					0	0	0	3	5	0	0	0	0	3	3	3	0	0	3	0
Acid dyers	Wide range	X	M	M	L	H	M	*	*					4	4	2	1	1	0	0	0	0	0	0	1	0	0	1	0
Basic dyers	Wide range	X	L	X	X	H	L	*	*					4	4	2	1	1	0	0	0	0	0	0	1	0	0	1	0
Basic dye bases	Wide range	X	L	X	X	H	L	*	*					3	3	3	4	4	0	0	0	3	3	2	3	0	2	2	0

*Varies with individual formulations. †Letters and Numerals explained on facing page. [1]Discolor with S or Cu metal contact. [2]Varies within class. [3]Discolor in contact with copper. [4]Stains with sulfide. [5]Stains with sulfide. [6]Stains with sulfide. [7]Sulfide-stable. [8]Sulfide-stable. [9]The very red shades of blue crystallize in aromatics. [10]Color destroyed in reducing atmosphere. [11]Mostly used as flameproofer with Cl.

THIS CHART WAS PREPARED BY MR. HAL-CURTIS FELSHER, CLAREMONT PIGMENT DISPERSION CORP.

Property key
V—Very high
H—High
M—Moderate
L—Low
X—Very low

Applicability key
5—recommended
4—applicable
3—limited conditions
2—economy-low quality
1—not recommended
0—unsuitable

Processing conditions and pigment requirements for plastics

Molding phenolic: Mildly alkaline reducing, high heat.
Casting phenolic: Mildly alkaline or acid, long heating at moderate temperature.
Aminos: Mildly acid reducing, need light fastness.
Polyester: Strongly oxidizing; need light fastness.
Polyurethane: Strongly alkaline.
Nylon: High heat, strongly reducing.
Low-density polyethylene: Neutral, high temperature.
High-density polyethylene, polypropylene: Neutral, very high temperature.
PVC: Acidic, high temperature.
Acrylic: Need very good light fastness.
Polystyrene: High temperature and residual oxidizing catalyst.
Cellulosics: High temperature, neutral or slightly acidic.
Fluorocarbons: Extremely high temperature, need chemical resistance.
Silicones: Extremely high temperature, need light and heat fastness.
Epoxy: Moderately high temperature.
Polycarbonate: Very high temperature.

to vinyl plastisols, polyethylene, and styrene are currently under development, and several suppliers are working on metallic pigments for styrene (to be sold at a 5¢/lb. premium) that they hope will compete with vacuum metallizing as a decorating technique.

From the colorant supplier, the pigments and dyes can take several routes before winding up in a molded plastic product. These include:

1—Direct sales to resin suppliers who hot mix the colorants into their resins for re-sale to processors (large reprocessors and the very large molders who might have installed adequate facilities necessary for the job also fall into this same category).

2—Sales to compounders who prepare masterbatches by dispersing the colorant into solid mediums such as polyethylene and vinyl (these masterbatches in turn are sold to resin suppliers, processors, and reprocessors who add small amounts to unpigmented resins and mix in high shear equipment).

3—In cases where the colorant may have an adverse effect on the shelf life of the plastics, e.g. polyester and epoxy resins, the colorant is sold to compounders who disperse it in a liquid compatible with the resin in question, e.g., plasticizers such as dioctyl phthalate (DOP). These paste concentrates are then sold to molders who add them to the liquid resins by a simple stirring operation at the time catalysts, fillers, etc., are mixed in.

4—Sales to compounders who add the colorant to a gel coat for re-sale to molders who are doing hand lay-up operations at room temperatures and do not want to use paste concentrates for mixing their own colors.

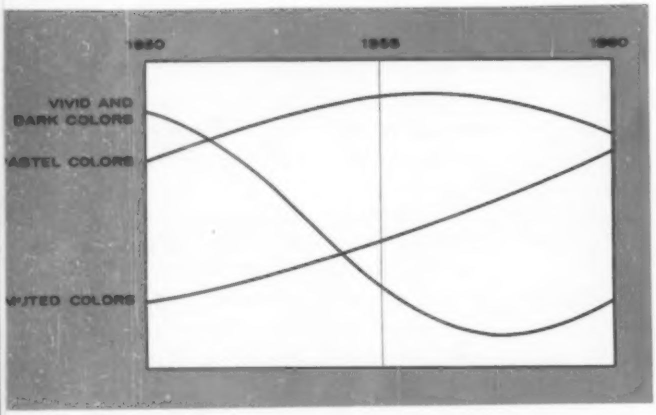
5—Direct sales of finely ground colorants in powder form (either in bulk or pre-packaged units) to molders who can do their own dry coloring by tumbling the powdered pigment and the resin granules together before passing the mix through the molding machine.

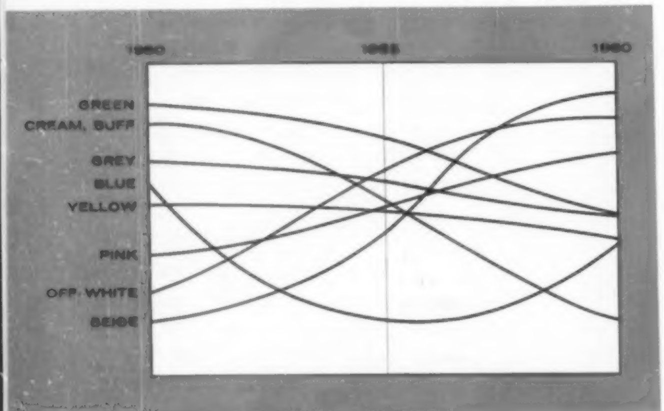
The business of color

Familiarity with this organizational set-up is of extreme importance to anyone in the plastics industry. No matter how you cut it, color and plastics are irrevocably tied together.

In styrene alone, approximately 60 to 75% of the total poundage molded or extruded is estimated to be in colored resin. On an average of 1½% colorant per pound and an annual resin consumption of about 660 million lb., this would figure out to about 6 to 7½ million lb. of pigments and dyes.

About 50% of polyethylene resin (or one-half billion lb.) is used in colored form (the other 50% is mostly in clear film). This would include the almost 62 million lb. of pipe and the 105 million lb. of wire and cable insulation which almost universally use carbon black for ultra-violet screening properties. At a 1% average, this would mean a market of about 1½ million lb. of carbon black. On a 2% average for the use of colorant in the remainder of polyethylene applications, the poundage of pig-





COLOR TRENDS—1950 TO 1960.

ments and dyes would be somewhere in the vicinity of 6½ million pounds.

If, as one analyst claims, almost 80% of all rigid plastics are sold in color, then any increase in plastics consumption will mean a proportional increase in color use.

Picking the color

With such a stake in color, it is surprising that many end-users still select color for their plastics products or components on the basis of personal taste, tradition, or prevailing trends in similar products. This may have been adequate when the industry was young, but it seems unlikely that such vague systems of selection are sufficient today.

The plastics industry is moving into what looks like one of the most color-conscious eras in its history. Colors used in plastics already run well into the hundreds—for some, thousands. As Dow Chemical Co.'s color styling service expresses it, "Some of the new colors now moving in boast hues of a subtlety seldom seen in plastics in the past, as blendable as any of the old, long-accepted neutrals, but unmistakably keyed to colors already evident as fashion leaders in the field."

Picking the right color can be based almost on the same sound principles that now go into picking the right plastic. Most of the major raw materials suppliers maintain color styling services that can be of considerable help to end-users and molders. As evidence, Faber Birren, color consultant for Du Pont, offers the following summary of today's color trends:

"Vivid and dark colors, which were popular around 1950, hit a low spot around 1958 and are at present on the way back. Pastels, usually good, hit their peak at the same time as the dark colors were in decline (1958) but are now easing off. On the horizon are soft, muted colors which seem destined to have a big play in the years ahead.

"As far as specific colors are concerned, green, once supreme, has declined at the direct expense of beige. Cream and buff have dropped in inverse ratio to the rise in demand for off-white. Blues, which once were at the top, fell sharply and are now on the way back with turquoise leading the parade. Pink has made a steady upward climb and yellow has about held its own." (See charts, left).

Picking the colorant

Actually, the processor need not know the exact properties of the colorant he is using. The study of pigments and dyes is a full-time job that can best be done by the suppliers.

What the processor should know, however, are the limitations within which the colorist works. In obtaining an accurate color match, it is essential for the processor to know that working at a certain mold temperature range may preclude the use of certain pigments as well as dyes, or that using a certain colorant in an outdoor application may, of course, mean bleeding or migration.

The key to a really successful color match is to provide the colorist with all the *specific processing conditions and end-use information* he must know to make a functional—as well as an aesthetic—selection of colorants. Here are some of the questions which the colorist must put to himself before making the final decision:

1—What are the processing and end use temperatures? One very broad "rule-of-thumb" is: Below 350° F. the general run of organic pigments and dyes is quite satisfactory; in the range between 350 and 500° F., certain organics (e.g., phthalocyanine pigments, some triphenylmethane dyes, selected indanthrene and anthra-

quinone pigments) can be used, depending on the time during which they will be subjected to such heats; above this range, the inorganics would be more apt to apply. There are, of course, exceptions to the rule. And again—let the colorist make the final decision. (See "Colorants for Plastics," pp. 82-83, for more complete and specific breakdowns.)

2—What light stability would be required in the finished product? Another rule-of-thumb: organic pigments are generally better than organic dyes, but usually inferior to the inorganics in this respect. However, this would limit the use of organics only where light stability is a paramount factor; for the general run of applications, they are adequate. (Also see "Colorants for Plastics").

3—What quality of dispersion is required for the particular end-use in mind? Dyes, which are soluble in most common solvents, can easily be incorporated into plastics. Pigments, on the other hand, require working in order to be dispersed evenly—some more than others. In this connection, the type of equipment available (ranging from simple fiber tumbling drums to such high shear mixing equipment as two-roll mills) plus the form in which the color is made available (whether dry powder, masterbatch, or paste) are determinants.

Working within this framework, the colorist can assess the relative cost of colorants and dispersing equipment, and make the necessary compromises that will bring the quality of color desired within the cost limits set by the manufacturer for adding color. In the color-sensitive appliance industry, for example, there would probably be no deviation in color matching allowed—despite the costs that are involved; in the less-sensitive toy and novelty fields where products have a relatively short life, quality coloring could probably be sacrificed to effect a significant cost advantage.

4—Does the end-use demand any specific requirements as far as the pH, alkali or acid resistance, or the toxicity of the particular colorant is concerned?

5—What components of the plastic system used (e.g., catalysts, antioxidants, accelerators, the pH of the resin, etc.) may come into conflict with the color system? As just one example, with polyvinyl chloride, it is well when using pyrazolone red to avoid high-acid, unsaturated, or tertiary plasticizers because of plate-out; when using phthalocyanine blue with vinyl, one would do well to avoid barium-cadmium stabilizers for the same reasons. **(To page 167)**

A basic glossary of color

Organic pigments are derived from coal tar distillates such as benzene, toluene, naphthalene, anthracene, or derivatives of these. They are somewhat limited in heat stability in all plastic systems (350 to 500° F. is generally top range). They have a wide range of shades of color—yellow, orange, red, blue, and green—have fairly high bulk values and relatively low gravities (1.3 to 2.0), fair to good light stability, extreme brightness or intensity of color, and very high tint value. Selected organic pigments have received wide acceptance in the polyethylene and vinyl, as well as the polyester industries.

Inorganic pigments are usually metallic oxides, lead salts, cadmium or mercury compounds, and carbon blacks. As a group, they have excellent heat stability and light stability in all plastic systems. With the exception of the lead salts, chrome yellow, and molybdate orange, they are stable at all plastic compounding temperatures. They are characterized by high gravities of 3.5 to 5.0, low tint value, and lack of intensity or brightness of color.

Dyestuffs are chemical compounds or mixtures which absorb certain wave lengths of light while transmitting others. Thus, they are transparent (as opposed to opaque pigments). In order for a dye to impart color to an object to be viewed by reflected light, a reflecting surface must be provided (e.g., a metallized back surface, a white pigment [1% titanium dioxide] dispersed in the part along with the dye, or a white substrate on which the dye is precipitated). Dyes are soluble in water and most common solvents, they offer excellent brightness, and are characterized by low specific gravity and often by high bulk in air. They are usually most suitable for rigid plastics such as styrene, acrylic, polycarbonates, polyesters, unplasticized polyvinyl chloride, cellulose acetate, and the like. They have poorer resistance to light and heat than pigments and a tendency to bleed or migrate in some of the flexible plastics, particularly polyethylene.

Greater strength and durability, lighter weight, and a projected reduction in manufacturing cost—that's why major manufacturer of firearms is switching from steel to fibrous glass-reinforced plastics

NOW—

Those who thought that fishing and archery equipment represented the limit of plastics' penetration in the field-and-stream market had the surprise of their lives when molded nylon rifle stocks were introduced two years ago. There's another surprise in store for them this season: glass-reinforced plastic shotgun barrels that replace conventional steel construction.

The result of five years' development work, the new barrels have been introduced by Winchester-Western Div., Olin Mathieson Corp., New Haven, Conn., on its Model 59 semi-automatic shotgun. According to the manufacturer, this constitutes the first basic change in barrel design in over 60 years.

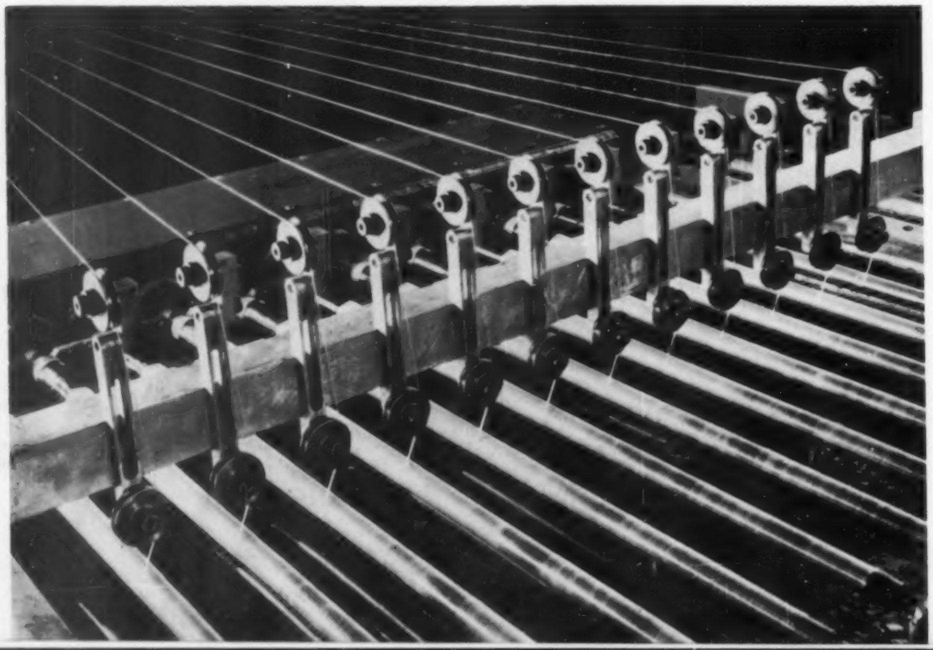
But the significance of this development is more than just historical. First, it shows how creative imagination can transform one idea (in this case, filament-wound pressure vessels) into apparently far removed applications. Second, it opens new avenues of development for related uses; perfection of a reinforced plastic shotgun barrel raises the possibility of rifle barrels, mortar barrels, and possibly barrels for even heavier weapons. Finally, it proves again how design in glass-plastics can improve a product at a reduction in manufacturing cost.

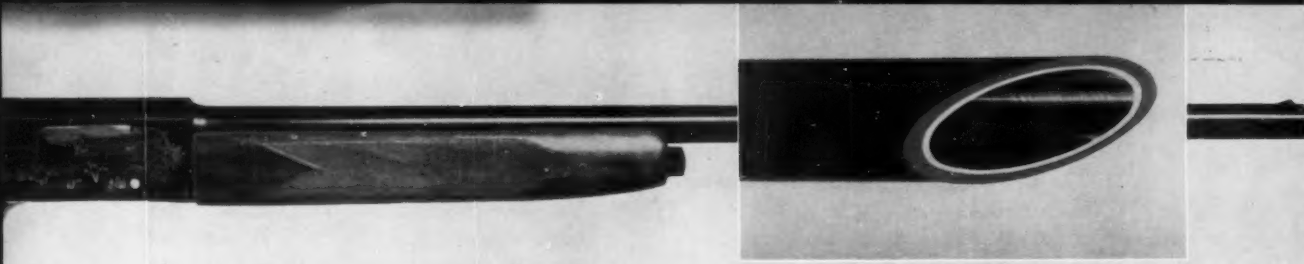
What brought the switch about

There were five major reasons for going from conventional steel to reinforced plastics:

1. Durability. The barrel and receiver can

SPINNING THE BARREL. Twelve-station unit processes 12 barrels at one time. Each strand consists of 10 filaments taken off spools from creel outside of view of photo. Preset Microswitches determine the exact winding pattern.





the plastic gun barrel

LIGHTEST-WEIGHT SHOTGUN has barrel made of filament-wound reinforced plastics. Close-up at right shows cut-away section, with thin metal sleeve on inside.

neither rust nor be affected by exposure to various kinds of weather.

2. Strength. Research and field tests reported by Winchester show that burst strength for the reinforced plastic barrel is greater than for that of steel. The barrel is designed for a tensile strength of 225,000 p.s.i.

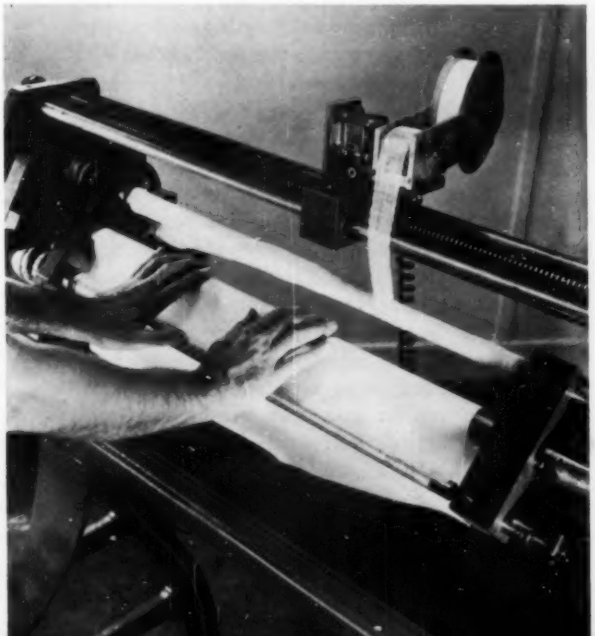
3. Heat absorbing qualities of the new construction eliminate hot barrels and heat wave distortion. At a recent demonstration at the New Haven plant, after 60 rounds of rapid fire, a typical barrel—while certainly not cool —was still touchable. A steel barrel, on the other hand, after such a torture test would be too hot to touch without burning the hand. The new barrel is also reported not to stick to one's skin when it is held in a bare hand in freezing weather.

4. Faster pointing. The new barrel contributes a significant weight reduction to the shotgun. The reinforced plastics barrel weighs about 30% less than the standard gun barrel. In terms of total gun weight, the new models weigh 6.5 lb., or about ½-lb. less than the lightest (aluminum receiver) shotgun made by the company.

5. Lower cost. While production start-up as well as limited initial output give a distorted cost figure, the company anticipates a lower-cost barrel when full volume is

The Winchester-Western Div., Olin Mathieson Corp., process for producing this gun is protected by Patent No. 2,847,786.

GAUZE is applied around plastic barrel convolutely wrapped with glass cloth. Lower part of the photograph shows operator applying unidirectional glass cloth to filament-wound barrel.



BARRELS ARE GROUND to smooth finish on five-station grinding machine, with each station having increasingly finer grit. Close-up below shows barrel moving past one station.

reached. Current retail price of the plastic gun is listed at $149.95.

The new barrel is essentially constructed of a thin cylindrical metal liner, a somewhat heavier threaded metal end, and a surrounding resin-glass structure.

Manufacture begins with the cylindrical liner, which is made from seamless drawn steel tubing with 0.020-in. wall (the wall of a standard barrel ranges from about 0.045 in. at the muzzle to over 0.125 in. at the breech). The liner is then wound with glass filaments pulled from a creel under tension as they pass through an epoxy resin bath. Glass filaments are of 150-1/0 type supplied by Owens-Corning Fiberglas Corp., and Johns-Manville, with P016 (Owens-Corning) and HSK (Johns-Manville) finish. Epoxies currently used are supplied by Shell Chemical Corp., (Epon 820) and Ciba (Araldite 6005), and are characterized by low viscosities, long pot life, and low volatiles.

The actual winding takes place on a 12-station machine handling a dozen barrels at one time. The barrels are mounted on synchronized spindles rotating at about 700 r.p.m. A traveling cross-beam moves back and forth to form the specially designed winding pattern. Movement of the beam is controlled by a series of preset Microswitches. The pattern is essentially a tightly spaced spiral, but it was modified to overlap in such a way that the barrel, which began as a cylindrical shape, assumes a conical configuration, with the greatest amount of glass reinforcement at a point nearest the firing chamber—where greatest strength is needed.

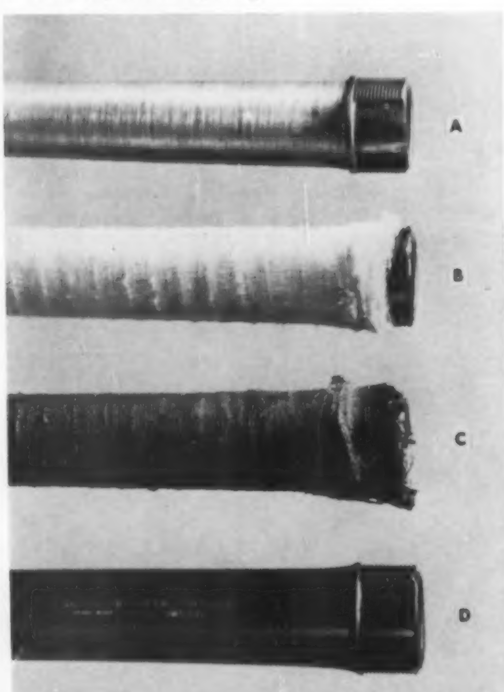
It takes about 10 min. to wind a set of 12 barrels, not counting change-over time. One 12-station winding unit is designed for an annual capacity of 25,000 barrels per shift.

After winding, the barrel is oven-cured and lightly sanded for contour and to provide a roughened surface for additional application of glass. The second application, which consists of a unidirectional woven glass cloth (type 43), provides longitudinal strength.

This cloth is wrapped dry onto the barrel and is snugged tightly to the filament-wound structure by a wrapping of expendable cotton gauze, using a Winchester-designed machine. After being wrapped, the barrel is once more oven dried and then impregnated with a proprietary epoxy compound under high vacuum (0.1 mm. Hg). Impregnated barrels are oven-cured and then ground and polished to finish contours on a machine incorporating five stations of increasingly finer grit size. This grinding unit, as well as the winding equipment, are all Winchester designed and built.

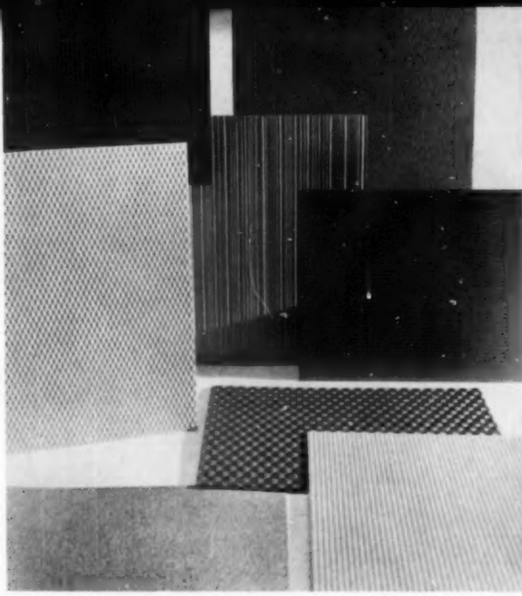
The ground barrel is given a final spray finish of a prime coat and finish coat of epoxy based baking enamel, supplied by Egyptian Lacquer Co. Aluminum holding lug and front sight are bonded directly to the finished barrel with epoxy based adhesives.

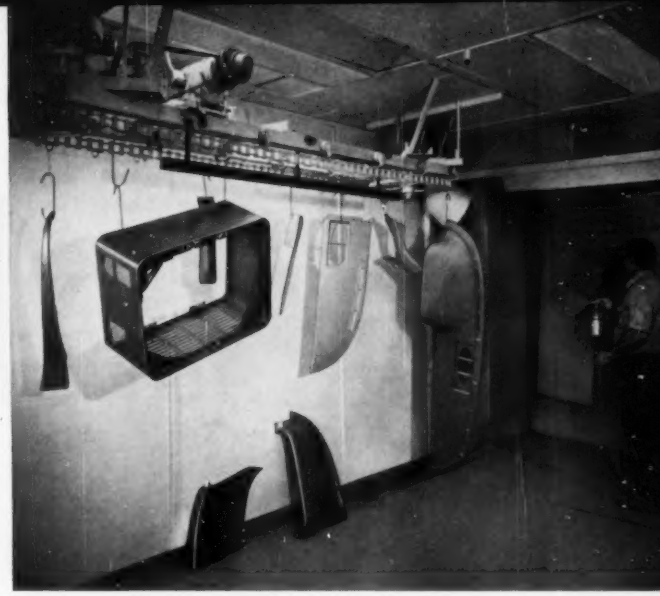
FOUR STAGES in production of the Winchester plastic gun barrel: **A**—filament-wound barrel; **B**—expendable gauze wrapped tightly around woven cloth before impregnation; **C**—same structure after vacuum impregnation; **D**—finished barrel, after lacquering.



What about the future

According to company spokesmen, initial customer reaction has been very favorable, and there are indications that the company may switch other barrels to the new construction. The greatest difficulty involved was obtaining and training qualified personnel. These have now been overcome and production is running smoothly. Government agencies are interested in this type of construction and research programs in this area are underway. Perhaps the day of the essentially all plastics rifle is not too far distant.—**End**





TYPICAL TEXTURED metal sample panels sprayed with vinyl organosol finish are shown at left. At right is a view of a variety of sample parts being sprayed with the new vinyl finish. Included are several dashboard specimens and automobile interior trim elements. Also being coated is an experimental television cabinet fabricated of smooth metal. It will receive multi-color sprayed organosol finish to simulate a pigskin effect.

Spray-applied vinyl finishes for metal products

Dip-coating of metal products with vinyl plastisols and organosols has been standard practice for years. Vinyl paints have also been with us for some time. Vinyl-metal laminates, wherein a calendered sheet is laminated to metal, have been on the market for almost a decade. Within the past two years plastisol-coated and post-embossed metals have been offered to the fabrication field.

Now there has been developed a new system for spray-application of decorative vinyl finishes to plain or textured steel or aluminum products after they have been fabricated. The new development, product of Metal & Thermit Corp., New York, N. Y., challenges pre-laminated and pre-coated metal sheet which had a sale of over 30 million square feet in 1959.

The difference in the new spray and oven-bake system is that the metal, to have a decorative texture, must itself be textured, the grain telegraphing through the vinyl coating.

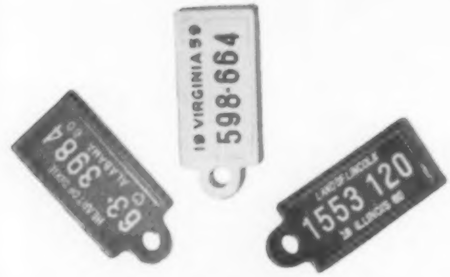
Both plastisols and organosols are used, depending upon the hardness and thickness of the coating required. Organosols form a harder coating than plastisols, but because of volatiles in the mix, only up to 15 mils can be applied in a single spray application. Where thicker and more resilient coatings are required, such as in dishwasher tank linings and on heavy industrial jobs, plastisols are recommended.

Literally any color can be matched in the new spray vinyl finishes, including metal tones, spatter, and multi-color effects.

Several advantages are claimed for the new system. Standard spray equipment, including electrostatic spray may be used. Welding and forming operations are done prior to coating. Finish can be sprayed on complex shapes. No raw edges are evidenced. Little or no inventory is involved. Pattern coating can be done by the use of masks. Costs for a 5-mil coat of organosol per square foot in volume production averages 14¢; for 12 mils of spray-applied plastisol cost is estimated at 12¢ per square foot.

Since the coatings are thixotropic (non drip), the finish retains its applied thickness through the oven treatment at between 350 and 420° F. depending on the material used, the size of part, and the coating thickness.

First applications of the new development are in the appliance, automotive, and business machine fields.—**End**



HOT-STAMPED TAGS

Cellulose acetate key tags, hot-stamped with state name and license information, are gradually replacing metal-and-paper types, and will eventually save an estimated $280,000 per year for the Idento Tag program of the Disabled American Veterans. This program, the only major fund raising campaign of the non-profit organization, relies upon voluntary contributions from those who have received the small license plate key tags.

The plastic tags, costing about $3 per thousand, are replacing those made of stamped metal blanks and printed paper inserts, which cost approximately $7 per thousand. Thus, on the predicted yearly production of 70 million tags, the new plastic tags should save about $280,000 annually.

Blank acetate tags are furnished by Adams Plastic Products Co., Cincinnati, Ohio, which injection molds them on an 8-oz. Fellows machine in an 80-cavity mold from material supplied by Eastman Chemical Products Inc. These blanks are then hot-stamped at the DAV's Cincinnati headquarters, with the disabled veterans operating the stamping equipment. Rate of production on the tags averages about 22,000 pieces for an 8-hr. work day.

The hot-stamping operation

The hot-stamping machine used is an Acromark Model 2AHS, made by The Acromark Co., Elizabeth, N. J., and adapted to handle three modular die heads. The company also furnishes resinous pigment tape for stamping. The machine incorporates a 12-station rotary feeder table with automatic feed and ejection

MODULAR HEADS are used on hot-stamping equipment, permitting fast, easy die changing. Rotary stamper (right) and two ram-pressure heads impart license information (shown in color) for the Illinois tag.

By switching from metal-and-paper to molded acetate license tags, DAV effects major production economies on a 70-million-unit run to improve its rehabilitation programs

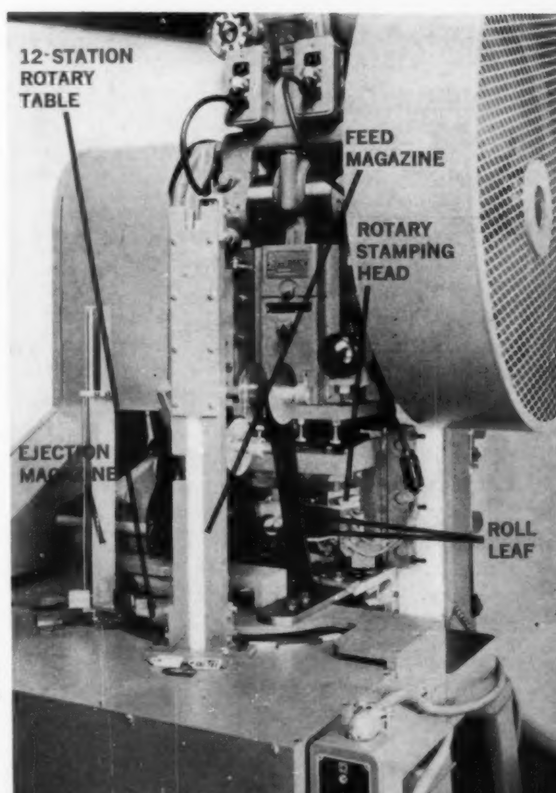
SAVE $1/4 MILLION

PRODUCTION LINE for key tags at DAV's Cincinnati headquarters. Hot-stamping machines are operated by disabled veterans themselves.

magazines, multiple tape feed, automatic pressure and dwell controls, and electrically heated and controlled die heads.

The blank tags are strung on a spindle, which resembles a large knitting needle, and secured with a spring clip. The spindle, containing about 200 tags, is placed in the feed magazine and the spring clip removed. Tags are fed from the bottom of the magazine by cam action onto the rotary table, which then carries them to the stamping stations. As each tag comes into place, the die head presses the roll tape against it, and a combination of heat and pressure transfers the resin-pigment formulation to the license plate key tag.

No more than three stamping (**To page 175**)



CLOSE-UP VIEW of hot-stamping machine, labeled to show key stamping components. All operations are automatically controlled by front switches.

More progress in

SELF-EXTINGUISHING PLASTICS

The lead article in the September 1959 issue of Modern Plastics explored the problems of the building codes, regulations, tests and standards that the plastics industries face in the matter of flame resistance, and outlined the problems that are involved in making plastics self-extinguishing.

Then, in our November issue we presented the first chart of self-extinguishing plastics materials, covering resins and molding compounds, film, sheeting, laminates and foams. At that time we stated that the chart was likely to be rendered incomplete and partially obsolete by continuing research and developments.

The chart opposite this page contains additional sources and information on self-extinguishing plastics which further editorial research has recorded. It is the same width and in the same format as the November chart. In using both of these charts, the following information is of extreme importance:

What tests measure

ASTM D-635 and ASTM D-568 are tentative tests. D-635 is for determining rate of burning of plastics specimens 0.050 in. and thicker; D-568 is for specimens under 0.050 in. thick.

ASTM D-876 is a tentative method for testing non-rigid polyvinyl chloride tubing.

In the Film, Sheeting and Laminates Chart and also in the Foams Chart, there are several references to ASTM D-1692. Again, this is a tentative test to be used to gage flammability of plastics sheeting and foams. In Part II of the chart, though, reference is given to ASTM D-757, which is a *standard* method for evaluating the flammability of rigid plastic sheets or plates ⅛-in. thick.

Several references are made to the Underwriters' Laboratories test and that of the National Electrical Manufacturers Assn. In the UL test, a ⅛-in. thick specimen is held horizontally in a gas flame for 10 sec., and results are expressed as time to extinguishing once the flame has been removed. The NEMA test was developed by that organization's switchgear committee, using modified Bureau of Mines apparatus. The results are expressed in ignition and extinguishing time in seconds on specimens ½ by ½ by 5 in. in size.

References to CS-192-53 on the chart indicates use of an S.P.I. 45° flammability test for film 0.004-in. thick and greater.

References to the S.P.I. test on the Foams Chart denote a flammability test proposed by the Cellular Plastics Div. of S.P.I.

In addition to the basic military test, designated MIL-M-14F, there is a related test known as MIL-M-14E.

A reference to a Civil Aeronautics test in Part II of the chart denotes use of that administration's safety regulation release #259.

It will be seen that only the UL test, the S.P.I. film flammability test, the ASTM D-757 method, the military specification test and the Civil Aeronautics regulation are firmly entrenched as *modus operandi*. The other tests referred to in the chart and pointed up here are all tentative, although the other ASTM tests are now quite generally used in evaluating the self-extinguishing properties of plastics.

The generally accepted definition of self-extinguishing materials is that they should not burn once an outside source of flame is removed, although they may be combustible while the outside source of heat is present.

Of course, regardless of building codes, tests and comparative claims, rendering materials self-extinguishing, particularly by halogen additives, can affect other properties which in turn may have effects on design of part, design of mold, cure cycle, odor, toxicity, density, etc. It is important to the processor that the self-extinguishing material be related not only to the exact application but to the process. Material makers listed here have extensive literature on each of the materials tabulated.—**End**

Those who have purchased additional copies of the original November 1959 chart automatically receive, free of charge, this addition. A complete set of charts (Parts I and II) may be obtained—at 50¢ per set prepaid—by writing to Readers' Service Dept., MODERN PLASTICS Magazine, 575 Madison Ave., New York 22, N.Y.

Complete set of charts (Parts I and II) is available at 50¢ per set (prepaid only) in quantities up to 99. Quotations for quantity orders (100 copies and up) available on request. Write Modern Plastics Magazine, Readers' Service Dept., 575 Madison Ave., New York 22, N.Y.

MODERN PLASTICS CH

RESINS AND MOLDING COMP

MANUFACTURER	TRADE NAME AND NUMBER	TYPE OF RESIN USED	TESTS PASSED	TENSILE STRENGTH AT 72°F, PSI	IMPACT, NOTCHED IZOD AT 72° F FT-LB/IN OF NOTCH	HARDNESS (1)	SPECIFIC GRAVITY
DIAMOND ALKALI CO.	Same data as on November issue chart except—						
FIRESTONE PLASTICS CO., Div. of Firestone Tire and Rubber Co.	Exon 461	Fluorine-containing thermoplastic resin		4,500-5,500	0.5-1.0	75-85(R)	1.70
"	Exon 905, 915F, 924, 450, 468-R, 495	Polyvinyl Chloride and PVC Copolymer	MIL-M-14F	1,940-3,800		68-100(A)	1.20-1:50
"	Nylon 200, 210	Nylon	ASTM D635	10,000	1.2	118(R)	1.13
GLASKYD, INC.	Glaskyd 1901, 3001, 2201, 2001	Alkyd	"	4,000-9,000	1.5-4.0	60-70(B)	2.1-2.3
"	Glaskyd 2051B	"	MIL-M-14E	7,000-9,000	3.0-4.0	60-65(B)	2.3
THE MARBLETTE CORP.	Marblette 76, 77, 81	Phenolic	ASTM D635 MIL-M-14F	6,000-7,000	0.45	85(M)	1.3
"	Maraset 110E, 121E, 131E, 150E, 141E	Epoxy	ASTM D635	10,000	0.4-0.6	80(M)	1.5
NAUGATUCK CHEMICAL	Marvinol rigid compound NR-7051, NR-7055, NR-7058, NR-7070, NR-7080	Polyvinyl Chloride	"	6,400-7,500	0.5-10.0	105-116(R)	1.32-1.44
"	Marvinol compound NR-7056	"	"	5,100	14.0	100(R)	1.34
PLUMB CHEMICAL CORP.	Fibercore 3000	Polyester (premix)	"	6,000-10,000	14.0-20.0	98(M)	1.93
ROGERS CORP.	RX330, RX431, RX448, RX460, RX468, RX470, RX490, RX495, RX525, RX825	Phenolic	ASTM D635 MIL-M-14F UL Test (2)	4,600-7,500	0.4-2.0		1.37-2.02
"	RX1260, RX1360	Diallyl Phthalate	ASTM D635 MIL-M-14F UL Test	4,700-7,000	0.8	103-110(M)	1.59-1.81
UNION CARBIDE PLASTICS CO.	Bakelite BMG-0500 Black 25, BMG-0750 Natural, BMG-5261 Black 25	Phenolic	ASTM D635 MIL-M-14F	5,000-7,000	0.2-0.3	90-113 (M)	1.58-1.92
"	Bakelite ERLB-0625	Chlorinated Epoxy					1.37
"	Bakelite QND-5568, QND-5590	Polyvinyl Chloride	ASTM D635 ASTM D568	1,600-1,900		68-90 (A)	1.23-1.42
"	Bakelite VND-9734, VND-9960	Vinyl Chloride, Vinyl Acetate Copolymer	"	1,200-1,400		60 (A)	1.25-1.35

FILM, SHEETING, LAMINA

MANUFACTURER	TRADE NAME AND NUMBER	TYPE OF RESIN USED	TESTS PASSED	TENSILE STRENGTH AT 72°F, PSI	IMPACT, NOTCHED IZOD AT 72° F FT-LB/IN OF NOTCH	HARDNESS (1)	SPECIF GRAVIT
CELANESE CORP. OF AMERICA	L-822, L-864, L-865	Cellulose acetate	ASTM D568	10,000-12,000			1.31
"	S-700, S-704, S-715	"	ASTM D635	4,000-8,000	1.0 to 3.0	95-110(R)	1.28-1.3
"	S-716, S-729	"	ASTM D568	7,000-8,000			1.29-1.3
"	P-911, XCA-14756	"	"	7,000-8,000			1.31
CINCINNATI DEVELOPMENT & MFG. CO.	SSFR & X#2 FR Insulstruc	Polyester	ASTM D635 ASTM D757 (3) UL Test	9,000-12,000	11.0-14.0	102-117(R)	1.75-1.

*Part 1 of this chart appeared opposite page 90 of the November 1959 issue of Modern Plastics. 1. Scales: M&R – Rockwell; A & D – Shore Durometer
5. Denotes proposed NEMA Switchgear Committee Test. 6. Denotes Civil Aeronautics Administration Safety Regulation Release #259.

Cut along dotted line.

HART OF SELF-EXTINGUISHING

MPOUNDS

ECIFIC AVITY	HEAT DISTORTION POINTS °F	DIELECTRIC STRENGTH V/M	LIGHT STA-BILITY	COLORS AVAILABLE
→	→	→	Good	See November issue chart
1.70		900	Excel-lent	Clear
20-1:50		650-1,280	Good	Wide range
.13	150 @ 264 psi	420	"	"
1-2.3	> 400 @ 264 psi	ST 330-420 S/S 275-390	Good	Wide range
2.3	> 400 @ 264 psi	ST 309 S/S 277	"	Gray
1.3	250 @ 250 psi	350-400	Fair	Orange, brown, white
1.5	293 @ 250 psi	400-450	Very Good	As requested
2-1.44	149-167 @ 250 psi		Good to excel-lent	Standard and special
1.34	151 @ 250 psi		Good	Black, natural, gray
1.93	540 @ 264 psi	310 - 360	"	Wide range
37-2.02	300 - > 500 @ 264 psi	to 300	Fair	Black, brown, natural
59-1.81	340 @ 264 psi	440 - 450	Excel-lent	Wide range
58-1.92	300-400 @ 264 psi	ST 275-375	Poor	Brown, black, natural
1.37			Good	Natural
23-1.42			"	Opaque
25-1.35			"	"

NATES

PECIFIC RAVITY	HEAT DISTORTION POINTS °F	DIELECTRIC STRENGTH V/M	LIGHT STA-BILITY	COLORS AVAILABLE
1.31		1,000-3,000	Excel-lent	Clear transparent
28-1.32	130 - 160 @ 264 psi	300 - 700	"	Clear and pigmented
29-1.32		1,100-1,200	"	"
1.31		2,000-3,000	"	Clear transparent
.75-1.9		375-400		Tan, red, gray

FILM, S

MANUFACTURER	TRADE AND NU
FIRESTONE PLASTICS CO., Division of Firestone Tire and Rubber Co.	Velon FR, S FA, EP, F. Series
"	Velon IF, II PB Series
"	Velon GR, F FH, GH Se
GENERAL ELECTRIC CO.	Texolite 115 11508
"	Textolite 11 11555, 115
"	Textolite 11 11574
THE MARBLETTE CORP.	Marblette 1,
"	Maraset 148 121F
THE RICHARDSON CO.	Insurok T-9
"	Insurok T-7 T-816, T-8 T-878, T-8
ROGERS CORP.	Duroid 225F 800 FR
"	Duroid RL4
"	Duroid 5600 5613, 5650 5813, 5870
ST. REGIS PAPER CO., Panelite Div.	Panelite 55 743
"	Panelite 13
"	Panelite 16 853
"	Panelite 14
SEIBERLING RUBBER CO., Plastics Div.	Seilon S-3 F
"	Seilon VHI, TTT
"	Seilon LC
"	Seilon CR, CRT
UNION CARBIDE PLASTICS CO.	Bakelite Q 5962
"	Bakelite V 3310, 3353 3355, 3420 3604, 3606
"	Krene KDA 2070, 218 2276, 239 2905,

meter; B – Barcol. 2. Denotes Underwriters Laboratories flammability test for 1/8" thick specimen. 3. Denotes standard AST

IG PLASTICS MATERIALS–II*

, SHEETING, LAMINATES (Continued)

RADE NAME ND NUMBER	TYPE OF RESIN USED	TESTS PASSED	TENSILE STRENGTH AT 72°F, PSI	IMPACT, NOTCHED IZOD AT 72° F FT-LB/IN OF NOTCH	HARDNESS (1)	SPECIFIC GRAVITY	HEAT DISTORTION POINTS °F	DIELECTRIC STRENGTH V/M	LIGHT STABILITY	COLORS AVAILABLE
FR, SD, FE, P, FJ	Polyvinyl Chloride	CS-192-53 (4)	2,000-3,500			1.24 & up			Fair to very good	Natural, translucent, and opaque
F, IL, ries	"	"	2,000-2,500			"			"	"
GR, FI, H Series	"	ASTM D568	"			"			"	"
e 11512,	Melamine	ASTM D635	38,200-39,000	12.7-16.0	122-123(R)	1.87-1.90		S/S 300-395, perp. to lam.	Good	Natural
ite 11523, , 11556	Silicone	"	9,300-40,000	9.0-20.0	98-103(R)	1.60-1.77		S/S 225-270, perp. to lam.	"	Natural, white
ite 11559,	Epoxy	"	12,000-45,000	0.6-9.0	95-109(R)	1.43-1.95		S/S 490-550, perp. to lam.	"	Natural
tte 1, 186	Phenolic	ASTM D635 MIL-M-14F	6,000-7,000	0.45	85(M)	1.3	250 @ 250 psi	350-400	Fair	As requested
t 148F,	Epoxy	ASTM D635	10,000	0.4-0.6	80(M)	1.5	293 @ 250 psi	400-450	Very Good	"
k T-901	Modified Phenolic	ASTM D635 UL Test	15,000	0.36	110(M)	1.4		ST 600 S/S 450	Good	Maroon
T-714, , T-859, , T-892	Melamine	ASTM D635	13,000-35,000	0.7-12.0	109-120(M)	1.5-1.9		ST 420-475 S/S 340-375	"	Grayish white, coral, natural brown, natural gray
225FR, R	Modified Phenolic	ASTM D635 MIL-M-14F UL Test NEMA Test(5)	17,000-19,000		80-95(R)	1.2		350-500	Fair	Mahogany, black, natural
RL410	Phenolic	"	8,500	2.0	110(M)	1.8	Over 500 @ 264 psi		"	Black
5600, 5650, 5870	Reinforced Fluorocarbon	ASTM D635 MIL-M-14F	3,500-7,500	1.5-2.7		1.9-2.15	250 - over 500 @ 264 psi	125-300	Excellent	Standard
te 553,	Phenolic	ASTM D635	16,000-18,000	0.55-13.0	100-110(M)	1.36-1.41		ST 280-450		Maroon
te 130	Silicone	"	28,000	7.0	100(M)	1.7		ST 350		White
te 163,	Epoxy	"	20,000-40,000	0.5-15.0	110(M)	1.5-1.8		ST 550-650		Natural
te 140	Melamine	"	42,000	7.5	120(M)	1.9		ST 260		"
S-3 FR	Acrylonitrile, butadiene, styrene	Civil Aero (6)		8.0	100(R)	1.2	137 @ 264 psi 155 @ 66 psi 188 @ 0 load		Good	Wide range
VHI,	Polyvinyl Chloride Copolymer	ASTM D635 ASTM D568 MIL-M-14F	5,800-6,000	15.0-19.0	81-84(D)	1.4-1.5	145 - 158 @ 264 psi			Standard and as requested
LC	Rigid Vinyl Copolymer	"	8,800	0.4		1.35	142 @ 264 psi			"
CR, HI,	Unplasticized Polyvinyl Chloride	"	6,000-7-440	0.5-15.0	78-82(D)	1.39-1.43	155 - 165 @ 264 psi 165 - 175 @ 66 psi	608-1,085		Opaque, translucent, dark gray, blue gray, white, amber, green, non pigmented clear
ite QCA-	Polyvinyl Chloride	ASTM D568	9,000	0.5		1.43-1.55	71°C @ 264 psi	335	Fair	Opaque
ite VCA-3300, , 3353, 3354, , 3420, 3603, , 3606, 3610	Vinyl Chloride, Vinyl Acetate Copolymer	"	6,700-8,700	0.4-15.0		1.31-1.53	59.9-64°C @ 264 psi	425	"	Opaque, translucent opaque, translucent white, transparent
KDA-2066, , 2180, 2209, , 2396, 2607, ,	Polyvinyl Chloride, Vinyl Chloride-Vinyl Acetate Copolymer	CS-192-53	1,700-2,500		70-92 (A)	1.23-1.41			"	Clear, translucent, opaque

d ASTM method for evaluating flammability of rigid plastic sheets or plates 1/8" in thickness. 4. Denotes SPI 45° flammability test for film .004" thick and greater.

Roll-up records

Molded of rigid vinyl, disks 0.004 in. thin can easily be shipped in mailing tubes, yet provide high-fidelity reproduction. Volume usage in advertising and promotion is expected

WHILE EASILY BENT and rolled, fidelity of record remains unaffected throughout such handling. Manufacturer claims 100 playings per record without significant reduction in quality.

Chess players, dentists, and bobby soxers will form the first audiences for a new type of PVC record produced by Rank Audio Plastics, a division of Rank Records of America Inc., New York, N. Y. So thin that they can be easily rolled up into a cylindrical tube, the new disks are designated T.U.P. (thin, unbreakable, plastic) records. Although said to possess high fidelity, the records are not aimed at the jukebox business, but are intended as a new means of imparting technical information and as a sales promotion and advertising tool.

First runs off the presses went to Cardinal Industries Inc., Brooklyn, N. Y., for its University Chess package, where the record will impart basic chess instruction. *The Audio Journal of Dentistry*, Philadelphia, Pa., a semi-monthly tape recorded reel of condensations and excerpts from dental publications, is using the records as a sales promotion instrument to attract subscribers by acquainting dentists with the Journal's contents. Shamrock Hosiery Co., New York, N. Y., is distributing an initial order of 50,000 popular records with a line of socks for the teen-age group as a 59¢ promotional package in retail chain stores.

AMONG FIRST USES is instruction "book" incorporated in chess set, for which manufacturer considers it a potent sell-promotion device.

The manufacturer, a joint firm owned by the J. Arthur Rank motion picture organization of England, and Librairie Hachette of France, expects these records to have wide application in publishing, education, sales promotion and direct mail advertising, as an extension of the written and spoken word in classrooms, libraries, offices, and homes.

The new platters, 7-in. in diameter and weighing one-eighth of an ounce, are 4/1000th of an inch thick. They come in a complete range of speeds, including 33, 45, and 78 rpm., in black or white. They can be rolled in a mailing tube or can be inserted in books and magazines without special equipment. The records can be played hundreds of times, the company states. Price is 5½¢ for quantities of 5000.

Unplasticized PVC film, imported from Europe, is web-fed to a press made by Societé d'Applications Industrielles Plastiques, Paris, France, that "stamps" two records at a time (6000/hr). Pressed disks are blanked from the film on machines running at 3000 cuts/hr. Records are made by Consolidated Litho Corp., Carle Place, N. Y.—End

Photo, Deutsche Frigolit GmbH

DISPLAY STAND made from Styropor foam.

Styrene foam in

With the growing interest in European plastics developments, herewith is a report on the status of one segment of the industry in Germany: polystyrene foam.

In the Federal republic almost all the polystyrene foam produced is made from a raw material consisting of particles containing a blowing agent. The process is basically to heat the particles in steam to produce prefoamed particles, and to heat the prefoamed particles again in molds of the desired size to produce closed celled foams with densities of between 0.9 to 12.5 lb./cu. foot (1)[1]. Almost 70% of the foam produced has a density of under 1 lb./cu. ft. and is mainly used as a thermal insulation in refrigeration and building. About 20% of the foams are used in specialty applications. One of Germany's major suppliers offers three grades: general-purpose, self-extinguishing, and gasoline-oil resistance. Properties of German foams are essentially similar to those that are produced in the United States. (For reference, see "Foamed Plastics Chart," p. 513, *Modern Plastics Encyclopedia Issue for 1960.*)

The foams are used in the following fields:

Refrigeration

Very large numbers of cold stores, cooling machines, deep freeze containers, cooled display windows, fruit stores, dry ice containers and pipes are insulated with this material (2). It has been found that compared with cork insulation, styrene foam makes possible a 20% reduction in wall thickness (3).

The insulation of containers for cold storage and refrigerators is often foamed in one piece and the inner and outer housing are added in a later production step.

Building

Sheets of foam, 0.4 to 0.8 in. thick, are normally sufficient insulation to provide proper heat resistivity in inner and outer walls, ceilings, roofs, foundations, window sills, etc. (4). Roughened or sanded parts can easily be applied to the masonry or concrete with mortar and can be given a coat of plaster. Wall paper may be used with a 0.1 to 0.2-in. thick foam

*Badische Anilin & Soda-Fabrik AG, Ludwigshafen/Rhein, Germany.

[1]Numbers in parentheses link to references at the end of this article, p. 176.

PLANT CONTAINERS in variety of shapes and sizes made from expandable polystyrene.

Germany

By Dr. Fritz Stastny*

backing. Between floors they reduce sound transmission to the room below. Sheets that have been entirely perforated or whose surface has been perforated can be used as colored, sound-absorbing, decorative ceiling tiles.

A further application is in insulating flat roofs. For this purpose one side of the sheet of foam is covered with tarred paper and the underside is covered with corrugated cardboard which serves to ventilate the insulation and avoid the formation of condensation.

Prefabricated moldings and sandwich constructions have been successfully produced. Building units are prepared 13 to 26 ft. long, 3 to 6 ft. wide, comprising 2 to 2½ in. of reinforced concrete or expanded concrete with a foam insulation 0.8 to 1.2 in. thick. These support their own weight and may be used even in the construction of large blocks of flats. In other cases a steel skeleton is constructed and clad with sandwich sheets with a polyester coating on the outside. Prefabricated building units which have asbestos, aluminum, wood or normal building materials as the outer layer can be used for internal or external walls.

Packaging

Protective packaging with foams has many advantages including protection against mechanical stresses, thermal insulation of delicate goods, reduction of transport costs because of the packing's low weight, and protection against moisture.

The following methods have proved suitable in practice (5):

1. Packaging the goods directly. The foam consists of two or more sections which contain hollows in which the goods rest. When the sections are assembled, the goods are completely surrounded by the foam.

2. Insertion in large containers. This may be done by putting molded foam sections into the container which fit exactly, or by wedging thick sheets of foam or segments of foam between the wall of the container and the goods that are contained in it. (To page 176)

FABRICATED BLOCKS of styrene foam used as insulation for beer-brewing barrels.

Photo, Gruenzweig & Hartman AG

Plastics in the product revolution:

IN LATE-MODEL 8-mm. movie camera, embossed vinyl covering over die-cast housing provides scuff resistance and a warmth-to-the-touch feeling absent from all-metal construction.

Probably no other product owes as much of its sales and functional success to plastics as the simple, fixed-focus, mass-produced camera. Conversely, this product has had a tremendous effect on plastics development, and product and mold design.

When in July, 1934 the first Baby Brownie camera was introduced, Eastman Kodak Co. had already been involved in plastics for 45 years, since it had marketed cellulose nitrate photographic film as early as 1889. Now it uses molded plastics in camera manufacture to the extent of more than 3 million lb. a year.

The over 3 million lb. includes seven different kinds of plastics: cellulosics, polyethylene, nylon, phenolics, styrenes, epoxies, and methacrylates. Fifteen different formulations of these materials are used to achieve specialized properties, such as heat resistance, rigidity, or high impact strength. Of course, when different colors are used, the total number of formulations is even larger.

Originally, cameras were made of wood or cardboard, covered with artificial leather. Then came sheet metal, aluminum and zinc die-casting. Then came plastics, first in the Baby Brownie. That model, followed quickly by the Jiffy Vest Pocket Camera and the Bantam f/6.3, was molded from phenolics, since they were opaque, permitted latitude in design and were adaptable to large-scale production.

Interestingly enough, Eastman Kodak Co. found an early use for epoxy coatings on phenolic because of a problem created by good compression molding. This was to dull the slick inside surface of the moldings so that unwanted light would not bounce to film (See MPl, July 1958, p. 89).

Since the end of the war, a number of new cameras utilizing plastics have been developed. As more became known about multiple cavity molding, more engineering was designed into the moldings, which resulted in fewer parts.

Fewer parts, complex molds

Compare, for example, the Kodak Duaflex camera and the Brownie Starflash. The Duaflex has 120 parts, while the Starflash has only 72. In the Duaflex, itself, there are only two molded parts. In the Starflash, all major parts, excluding shutter, screws, diaphragm, rivets, and springs, are molded.

An outstanding example of the use of plastics, where nothing else would serve as well, is in the reflector for Kodak's flash holders. This Lumaclad reflector is made of a Tenite butyrate plastic shell. The shell is molded with optical precision to utilize the built-in mirror surfaces for the optimum in reflection. It emerges from the mold with a glass-smooth surface requiring no finishing or polishing. This plastic shell is then vacuum-metallized, which gives the reflector its mirror-like reflecting surface.

This is a perfect example of the use of an engineering material, in this case butyrate, which results in a better product. The plastic reflector is tougher can be deformed without breaking and will spring back to its original shape. It will not dent, has virtually no hot spots, and has better efficiency than its forerunner. It is light in weight. It can be molded to any reflecting curve, whereas other materials are limited in this respect. Complicated shapes, such as that of the reflector shown on the Starflash, would be prohibitive in cost if they were made

CAMERAS

THE COVER: In its evolution from the simple box of the early '30's to today's beautifully designed instrument, the fixed focus camera has gone all-plastics—even for those parts that look like metal.

Camera design has benefitted greatly from plastics usage since the introduction of the first fixed-focus variety. At the same time, plastics makers have learned a lot from camera producers

of metal. The design engineers like the plastic reflector because they can incorporate in the one molding more engineering and design ideas without an appreciable increase in cost.

In simpler cameras, use of plastics was almost a foregone conclusion, once they became available and the techniques of design and molding were perfected. While a molded part is completely finished, metal die-castings require additional treatment.

Beyond the camera

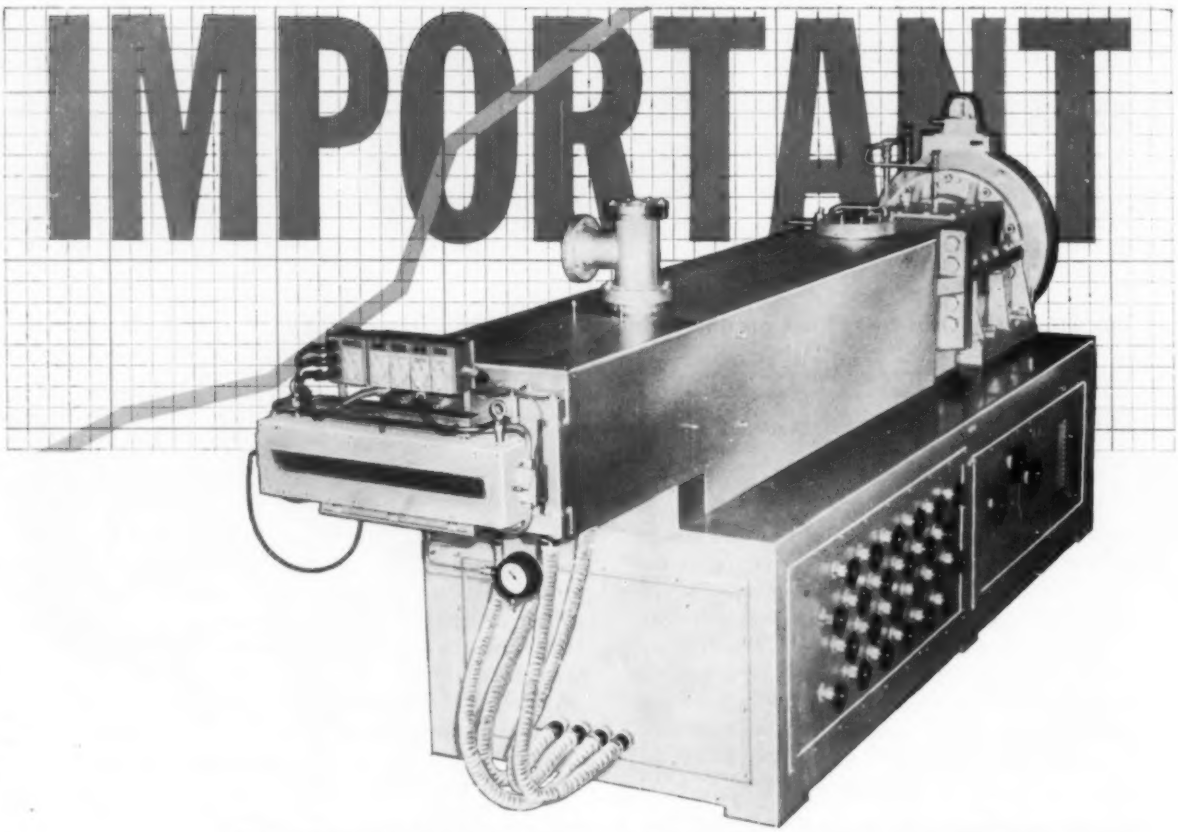
Not only Eastman Kodak Co. but Revere Camera Co. and Bell & Howell are using great amounts of plastics in more complicated photographic equipment, including motion picture cameras, projectors, and slide projectors. Molded acrylic is widely used for such components as the windows which admit light to the electric eye photocells on cameras so equipped, and in view finder assemblies. Nylon is widely used for gears, cams, and governor parts. Modified styrene is widely used for the slide carrying trays for projectors. Royalite ABS polymer is a standard material for carrying cases. On a single 8mm. Revere projector, there are 34 molded plastic parts, mostly nylon. These include worms, gears, knobs, cams, and impeller wheels, as well as electrical terminal blocks.

In the past year or two there has been a boom in slide projectors and a boom in plastics to make them. High-density polyethylene, high-impact styrene alloy, melamine, nylon, and vinyl-aluminum laminates have all been used as components and housings (see MPl, March 1959, p. 106).

Camera manufacturers too, have been leaders in experimentation with new materials. Because of the necessity of coupling corrosion resistance with absolute dimensional stability, such materials as Nylatron (filled nylon) and Fiberfil (glass-filled styrene), Delrin acetal resin, and Lexan polycarbonate received their earliest attention in camera factories.

So, while the camera and its accessory equipment owes a great deal to plastics for its sales and functional success, plastics are indebted to the camera manufacturer not only for a big volume of business but also for advancing the art of plastics application.—**End**

MOLDED PHENOLIC PARTS are assembled into complete camera units at Kodak. Epoxy enamel sprayed on inside surfaces cuts reflectance.



WELDING ENGINEERS COMPOUNDER-EXTRUDERS TURN IN HIGHER RATE RECORDS AND BETTER QUALITY QUOTAS WITH EACH NEW YEAR

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Vacuum hopper extrusion

By N. T. Flathers,† R. E. Johnson,† V. R. Pallas,† and W. Mayo Smith†

The economies and versatility of dry blend extrusion of PVC compounds can now be fully realized by use of a vacuum hopper. Heretofore, porosity and rough surface have precluded the use of dry blend extrusion in many applications. With a vacuum hopper, extrusions completely free of porosity, with marked improvements in surface appearance and physical properties can be obtained consistently. Products of high quality have been vacuum extruded from dry blends ranging from Type II rigid PVC to highly plasticized, highly filled compounds.

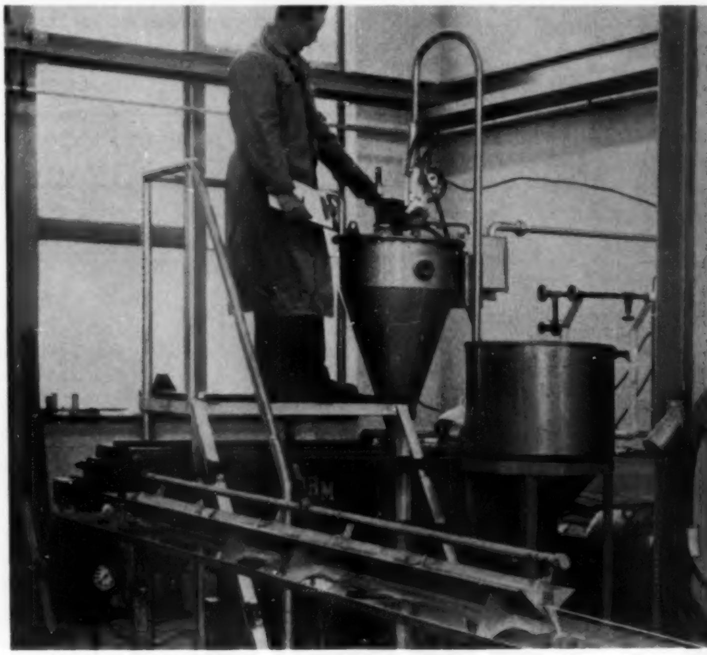
Dry blend extrusion of PVC compounds has been of interest for many years because of the economies and versatility which it offers. Savings of 3 to 10¢/lb. over diced compounds are reportedly realized. Other advantages are lower heat history and higher extrusion rates.

Some serious problems have been prevalent in dry blend extrusion, however. Porosity in the extruded product, especially when humidity is high, and poor surface quality have been particularly severe. Many processors have attempted dry-blend extrusion, but because of these problems have abandoned it. Others, after investing in dry blend equipment, for economic reasons extrude from dry blend, granulate and re-extrude in order to obtain an acceptable product. A partial solution to these problems has been achieved by improved screw design, valved extrusion and vented extrusion (1,2).[1]

Extensive work over the past several years in dry blend extrusion in Escambia Chemical Corp.'s Technical Service Laboratory indicated that the major causes of porosity and rough surface are associated with entrapped air and moisture in the dry blend. All phases of dry blend preparation and extrusion, including valved extrusion (3), were thoroughly investigated in an attempt to solve these problems. It became evident that the moisture and entrapped air should be eliminated from the blend prior to or immediately after entrance into the extruder cylinder. The use of a vacuum applied at the hopper appeared to be a logical approach.

At this phase in the investigation, a vacuum hopper manufactured by National Rubber Machinery Co. became available (4). This unit has been in regular operation in this laboratory and has shown great promise in overcoming these major problems. In

FIG. 1: Vacuum hopper installation with extruder set up for dry blend extrusion of vinyl insulated wire.



*Reg. U.S. Pat. Off.
†Escambia Chemical Corp., Research Center, Wilton, Conn.
[1]Numbers in parentheses link to references at end of article, p. 184.

Table I: Formulation for electrical dry blend compounds

Ingredients	*Formulations*[a] A	B	C
Escambia PVC-1250-E (relative viscosity approximately 2.40)	100	100	100
DOP	50	50	—
DDP-E	—	—	55
Clay	11	11	10
Calcium carbonate	—	—	20
Tribase	8.0	8.0	—
Basic lead carbonate	—	—	10
Antimony oxide	3.0	—	—
Mineral oil	2.0	2.0	—
Paraffin wax	—	—	0.5

[a]A and B are typical U.L. TW, 60° C. building wire compounds. Compound C is suitable also for 80° C. appliance wire. Formulations are given in parts by weight.

Fig. 1, p. 105, is shown the actual installation of the vacuum hopper, with the extruder set up for insulating wire. The hopper is a sealed steel bin under vacuum, with provision for constant level feed of the dry blend into the hopper from an outside source without interruption of the vacuum. In feeding the vacuum hopper and in conveying the material to the hopper, dry blends should have good flow properties.

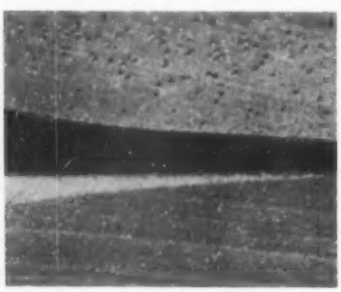


FIG. 2: Section of coating on vinyl insulated wire showing porosity in sample extruded without using a vacuum (top) and with vacuum (bottom). Magnification of photograph is 11.5×.

Escambia PVC Pearls (2000 and 3000 series) and resins (1000 series) were used. These resins, notably the Pearls, have large particles, can be hot dry blended with large amounts of plasticizer, and have good flow properties.

Results using a 2½ in., 20:1-L/D NRM extruder, are described below. A constant-pitch, decreasing-depth screw, 3.4:1 compression ratio, and a 5-flight metering section ⅛ in. deep, was used.

Several electrical compounds have been vacuum extruded from dry blends as coatings 1/32 in. thick on #14 AWG wire. The use of vacuum resulted in elimination of porosity improved retention of elongation after oven aging, and higher insulation resistance values. Three of the formulations are listed in Table I, left.

The degree of porosity was measured by the difference in the specific gravity of the porous insulation and non-porous milled compound and is reported as a percentage of the true specific gravity. The enlarged photograph in Fig. 2, left, shows a cross section of the insulated wires extruded with and without vacuum.

Physical properties

One of the most critical requirements for vinyl insulated wire as specified by Underwriters' Laboratories is retention of physical properties, particularly elongation, after oven-aging. Insulation made with Compounds A and B of Table I, extruded with and without vacuum, were oven-aged for seven days at 100° C. Insulation made with Compound C was aged for seven days at 113° C. Underwriters' Laboratories require a minimum of 65% retention of elongation for TW, 60° C. building wire (Compounds A and B) and 70% retention for 80° C. appliance wire (Compound C). Table II, below, shows percent retention of elongation after aging. In each formulation the use of the vacuum markedly increases the percent retention of elongation after oven-aging.

It is well known that the use of screw cooling by means of water or some other fluid is required to

Table II: Physical and electrical properties of several electrical compounds extruded from dry blend

Compound[a]	*Vacuum*	*Porosity*	*Retention of elongation after aging*	*Insulation resistance (Megohms per 1000 ft.)* 15.6° C.[b]	50° C. 1 Day	1 Week	2 Weeks	3 Weeks
	in.	%	%					
A	None	1.00	72	3100	88.1	150	182	180
	28.4	0	85	3050	96.9	178	218	216
B	None	1.10	68	2740	70.0	108	139	140
	25.5	0	76	2763	67.5	118	154	155
C	None	2.92	76	1040	25.0	43.3	50.6	50.3
	25.5	0	88	1140	25.8	43.8	51.8	51.3

[a]See Table I, above, for specific formulation.
[b]After 24 hr. at room temperature and 1 hr. at 15.6° C.

Table III: Effect of screw cooling on physical and electrical properties—electrical Compound B

Screw water temp.	*Wire speed*	*Porosity*	*Retention of elongation after aging*	*Insulation resistance (Megohms/1000 ft.)*				
				15.6° C.[a]	*50° C.*			
°F.	*ft./min.*	*%*	*%*		*1 Day*	*1 Week*	*2 Weeks*	*3 Weeks*
			Without vacuum					
70	160	1.10	68	2740	70.0	108	138	140
85	165	1.43	73	2688	65.3	100	129	130
150	200	1.88	80	2788	71.3	116	149	150
No water	305	5.04	70	2850	70.0	111	140	138
			With vacuum					
70	150	0	76	2763	67.5	118	154	155
85	160	0	79	2775	73.0	134	178	180
150	190	0	84	2670	71.0	120	157	159
No water	250	0	89	2650	70.0	124	160	161

[a]After 24 hr. at room temperature and 1 hr. at 15.6° C.

obtain high quality extrusions with some compounds. The use of screw cooling reduces extrusion rate, however. On the other hand, too little screw cooling results in rough surface. The amount of screw cooling required varies with the screw design, shallow-flight screws requiring less cooling. A study was made of the effect of screw water temperature on dry blend extrusion on wire with and without vacuum. The data obtained are shown in Table III, above.

Without vacuum the porosity increases as screw water temperature increases up to 150° F. Without screw cooling, the porosity is over 5 percent. The retention of elongation increases to a maximum at a screw water temperature of 150° F. and then decreases as the porosity becomes extremely high. The increases in retention of elongation with increase in porosity, an apparent contradiction, is probably due to an increase in stock temperature resulting from the higher screw temperature which overcomes the effect of porosity up to a certain point. With the vacuum, however, the porosity is eliminated even without screw cooling. In this case, retention of elongation increases with screw water temperature over the entire range. Thus, with the use of a vacuum hopper, the full advantage of higher extrusion rate obtainable by reduced screw cooling can be realized without porosity or rough surface, and improved physical and electrical properties are obtained.

Electrical properties

The insulation resistance of wires prepared in the two studies above are listed also in Tables II and III. The insulation resistance was measured as the average of two 50-ft. specimens of wire immersed in water at 15.6° C. and at 50° C. after 24 hr. and at weekly intervals up to three weeks. The values are well above minimum UL requirements of 150 megohms (1000 ft. at 15.6° C.) and 0.1 megohm (1000 ft. at 50° C.)

The data in Table II show that the use of the vacuum hopper improves the insulation resist-

FIG. 3: Clear vinyl strip extruded from dry blend, showing effects of vacuum and land length on quality. Note degrees of distortion of letters in back of strips.

FIG. 4: PVC tubing extruded from dry blend with (top) and without (bottom) vacuum. Sample without vacuum exhibits bubbles and surface roughness.

FIG. 5: Type II rigid PVC rod ½ in. in diam. showing effect of vacuum hopper in removing porosity and improving surface (right.)

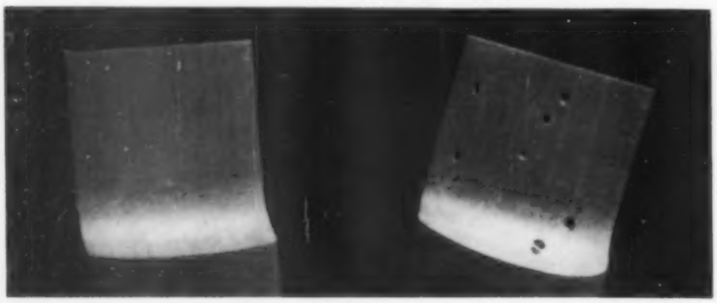


FIG. 6: Type II PVC strip ¼ by 1¼ in. showing effect of vacuum (left) on extrusion of dry blend.

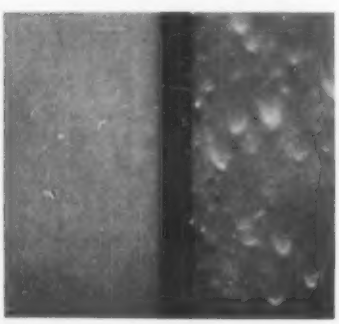


FIG. 7: Weatherstrip extruded from dry blend with (left) and without vacuum, showing improvements in surface quality using vacuum.

ance; higher insulation resistance values, especially at 50° C., are also generally observed in the wires made with vacuum at various screw water temperatures (Table III).

Work in this laboratory, before the acquisition of the vacuum hopper, showed definite advantages of dry-blend extrusion over diced extrusion in several electrical insulation formulations. Superior retention of elongation after oven-aging, higher insulation resistance, and increased extrusion rates were observed with dry blend extrusion. This was true even though porosity was present in most of the insulation extruded from dry blends. Uncontrollable porosity and rough surface were still problems. Porosity greater than 3% seriously affected physical properties after oven-aging. As shown by this present study, the vacuum hopper has eliminated these problems and has provided a means of obtaining consistently high quality wire insulation by dry blend extrusion.

The effect of the vacuum hopper on extrusion quality is visually dramatic with clear materials. The following formulation has been used for test purposes (number represents parts by weight):

Escambia PVC-3250[2]	100
DOP	44
Epoxy stearate	10
Liquid cadmium stabilizer	2
Stearic acid	0.2
Pigment	0.005

The effect of the vacuum hopper on eliminating porosity and improving surface quality in this compound is shown in Figs. 3 and 4, p. 107. The improvement in physical properties as tested on specimens of extruded strip is shown in Table IV, below.

Extrusion with a long land die without vacuum results in a product having no porosity but extremely rough surface (Fig. 3). This die has a rectangular opening ¼ in. by 1¼ in. and a land length of 2½ inches. The product extruded with a similar die having a ½-in. land length shows both porosity and rough surface. It is felt that the increased back pressure caused by the restriction of the long land die lowered the viscosity of the melt sufficiently to allow the entrapped volatiles to come to the surface and appear as roughness rather than porosity.

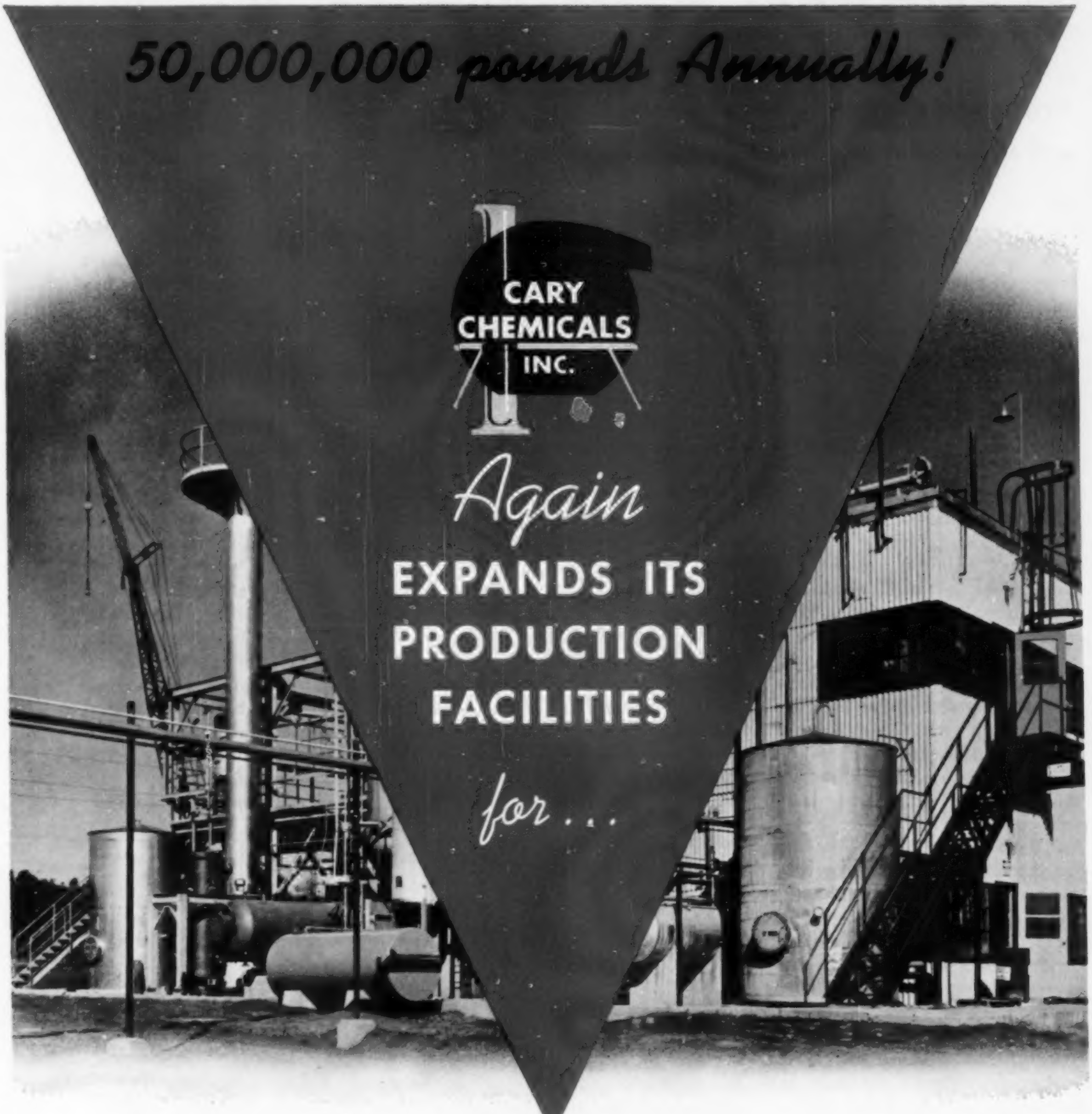
The flexible compound shown above was used to study the effect on porosity of moisture absorbed during storage. With freshly pre-prepared dry blends, extruded at approximately 70 lb./hr., porosity is eliminated in approximately 7 min. after application of vacuum. Two identical blends were stored for two weeks during the late summer, one exposed to open air and the other sealed in a PE bag. On extrusion under **(To page 179)**

Table IV: Physical properties of clear strip ¼ in. by 1¼ in.[a]

Process condition	*Porosity*	*100% modulus*	*Ultimate tensile strength*	*Elongation*
	%	p.s.i.	p.s.i.	%
Without vacuum	1.60	1470	2320	308
With vacuum	0	1570	2570	363

[a]Dumbbell Specimens—ASTM Die C (D412-51T). Average of five specimens.

[2]Relative viscosity approximately 2.40 (1% in cyclohexanone at 25° C.)



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Reciprocating screw injection machine

A report on the experiences of a U. S. molder with one of the new screw-piston injection machines

J. G. Fuller*

Although the reciprocating screw type injection machine has been available for almost two years in Europe, few have been used in this country. This article is one of the first reports on the performance of one of these machines by a domestic purchaser.

The results reported here were obtained on an Ankerwerk (Nurnberg, Germany) injection machine purchased in 1958 and shown in Fig. 1, below.

Figure 2, below, is a close-up of the cylinder section. The head and nozzle have been removed, exposing the needle nose of the screw with a section of plasticated vinyl cut out showing the extent of the forward travel of the screw during injection cycle. Notice also the spare screw being held alongside the cylinder to show length and configuration. Because of the piston-screw design, this machine has been found to combine the better plasticating and homogenizing abilities of an extruder with the high-pressure, fast filling characteristics of a plunger injection machine. It weds these two operations into a trouble free, fast cycling piece of equipment which can handle tough molding materials, such as Teflon 100-X and unplasticized vinyl compounds, or the easy-handling, lowest-molecular-weight polyethylenes.

How it works

Here are the important principles of operation in which the Ankerwerk machine differs from the conventional ram type machine. As shown in Fig. 3, p. 112, the injection cylinder is fitted with a screw having an L/D ratio of about 15:1 (will vary with size of machine). The screw doubles as a plunger and in addition to feeding the plastic pellets forward into the heating zones, it moves backward and forward to bring effective pressure on the softened plastic and inject it into the mold cavities. Immediately after the injection portion of the cycle, the screw is in position *A* of Fig. 3. As soon as gate sections have frozen, preventing back out from mold cavities, this screw is activated by a timer to begin rotation and plastication of the material for the next shot. As the screw rotates, it feeds molding powder pellets forward into the various heating zones and finally out into the needle nose sections of the screw.

The screw mechanism is so constructed as to allow the screw-plunger to back off as pressure is developed in front of it by the deposition of the fully homogenized and plasticated plastic. A measured amount of plasticated melt can be deposited in front of the screw by adjustment of limit switches, and when the screw has backed off the measured amount it stops rotating and remains in the fully charged position (*B* of Fig. 3) until the start of a new cycle. As the new cycle is started, the screw acts as a plunger and advances rapidly to position *A* completely purging the softened plastic in front of it.

It has been found that more effective injection pressure is realized with this machine than with the conventional ram because of 1) the elimination of partially plasticated pellets in front of the ram which cut down transfer of pressure from ram to molten plastic and 2) the absence of spiders and torpedoes which inhibit the flow of plastic and reduce transfer of effective pressures.

In addition, heat transfer is fa-

FIG. 1: Overall view of the reciprocating screw-piston Ankerwerk injection machine.

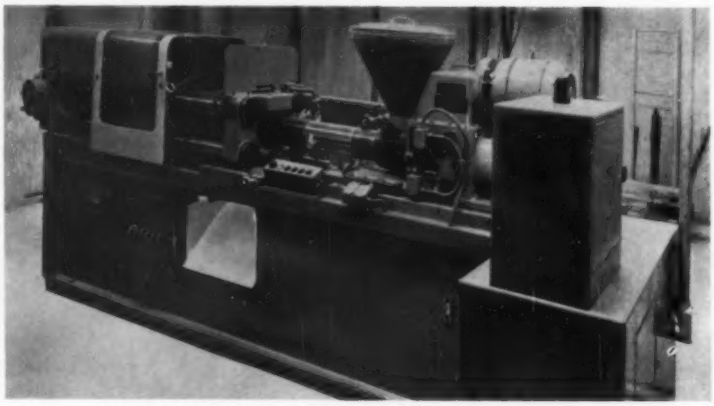
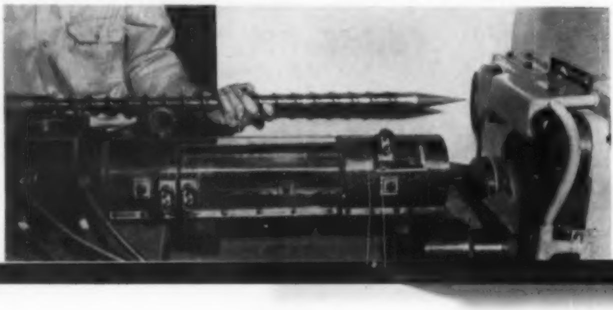
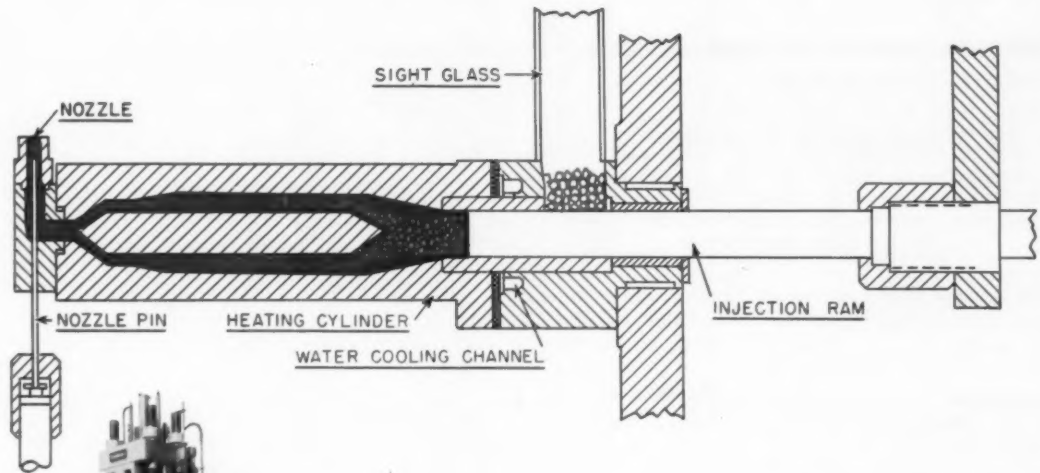
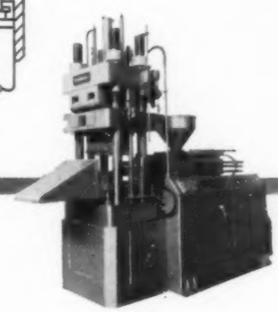


FIG. 2: Close-up of the retracted cylinder with screw protruding from the end. A spare piston is also shown illustrating the design of the screw.



*Vice President, Sales, Chemtrol Div. of Rexall Drug & Chemical Co., 10872 Stanford Ave., Lynwood, Calif.





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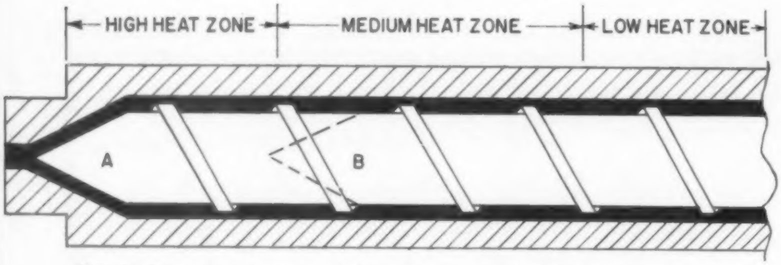


FIG. 3: Schematic diagram of the injection cylinder, showing heating scheme and illustrating the action of the screw-piston. With the point of the screw fully forward at position **A**, the chamber is fully emptied after a shot, except for clearance between flights of screw and wall. At point **B**, the rotating screw has filled the chamber in front of it and backed off to accommodate the charge of fully plasticated material.

cilitated because the screw acts as a torpedo carrying the plastic pellets out to the cylinder's heating surfaces as well as providing its own additional heat from masticating and working the material. The final flight of the screw-plunger has a clearance of 1/8 in. with the cylinder wall and uniform heating of the plastic is thus assured. Cleaning and purging of the machine is also aided by the design since the screw is essentially self-cleaning and there are virtually no dead spots in the cylinder where material can hang up and degrade. It is possible to change colors in a few shots, go from black to white or change polymers in 15 to 20 minutes. Using extrusion techniques, this cylinder can be pulled, the screw removed, and the completely cleaned assembly returned to the equipment ready for operation in less than an hour.

Because of greatly improved plastication, it is possible to mold at lower pressures, develop very rapid injection speeds, fill thick cavities without sinks and obtain strain free parts.

Molding a rigid PVC

Particularly significant is the ability of the machine to mold unplasticized polyvinyl chloride. Rigid PVC moldings are very difficult, if not impossible, to obtain on conventional plunger-type equipment. This material has a very high melt viscosity and is very susceptible to overheating and degradation. Rigid vinyls are not usually plasticated thoroughly by conventional plunger equipment, and the parts are full of partially knitted weld lines and non-molten particles.

Extrusion does a much better job and rigid PVC pipe properly extruded has high strength and good homogeneity. Molders of rigid vinyls have sometimes used extrusion in molding by first extruding a hot slug to a modified injection or transfer pot press. Rigid vinyl parts made in this manner have a good degree of strength and chemical resistance but the process is costly and leaves something to be desired in surface appearance.

The Ankerwerk machine effectively combines extrusion and injection in one machine. Because of the plasticating function of the screw, much lower cylinder wall temperatures can be used to reach injection viscosities and thus burning and degradation are virtually eliminated. Rapid filling and good welding is obtained even with the use of rigid vinyl. Thick sections without sinks are also made possible.

An example of quality of moldings obtained with this screw plasticizing machine can be seen in Fig. 4, below. This compares the quality of rigid PVC parts molded with conventional plunger equipment and those made on the Ankerwerk machine. Notice the almost complete degradation of the plunger molded parts due to thermal degradation during molding, poor plastication and welding of the rigid vinyl in plunger equipment. The acetone test is a common control test for rigid polyvinyl chloride moldings to show homogeneity as well as quality of molding.

Many types of plastics can be molded on the Ankerwerk machine, including high-density polyethylene, 100-X Teflon, PVC type II, PVC type I, polypropylene, and Penton. Very low melt viscosity materials, such as nylon and Penton, are easily processed with unique nozzle valves that eliminate drooling.

In summary, the screw-injection machine offers the following advantages over the conventional injection equipment:

1. More complete plastication at lower heats.

2. Delivery of more *effective* injection pressure, allowing use of lower machine pressures.

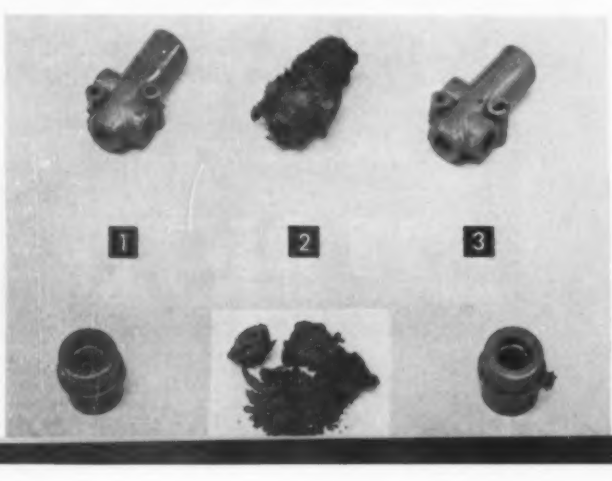
3. Ability to mold strain free parts without welds and sinks.

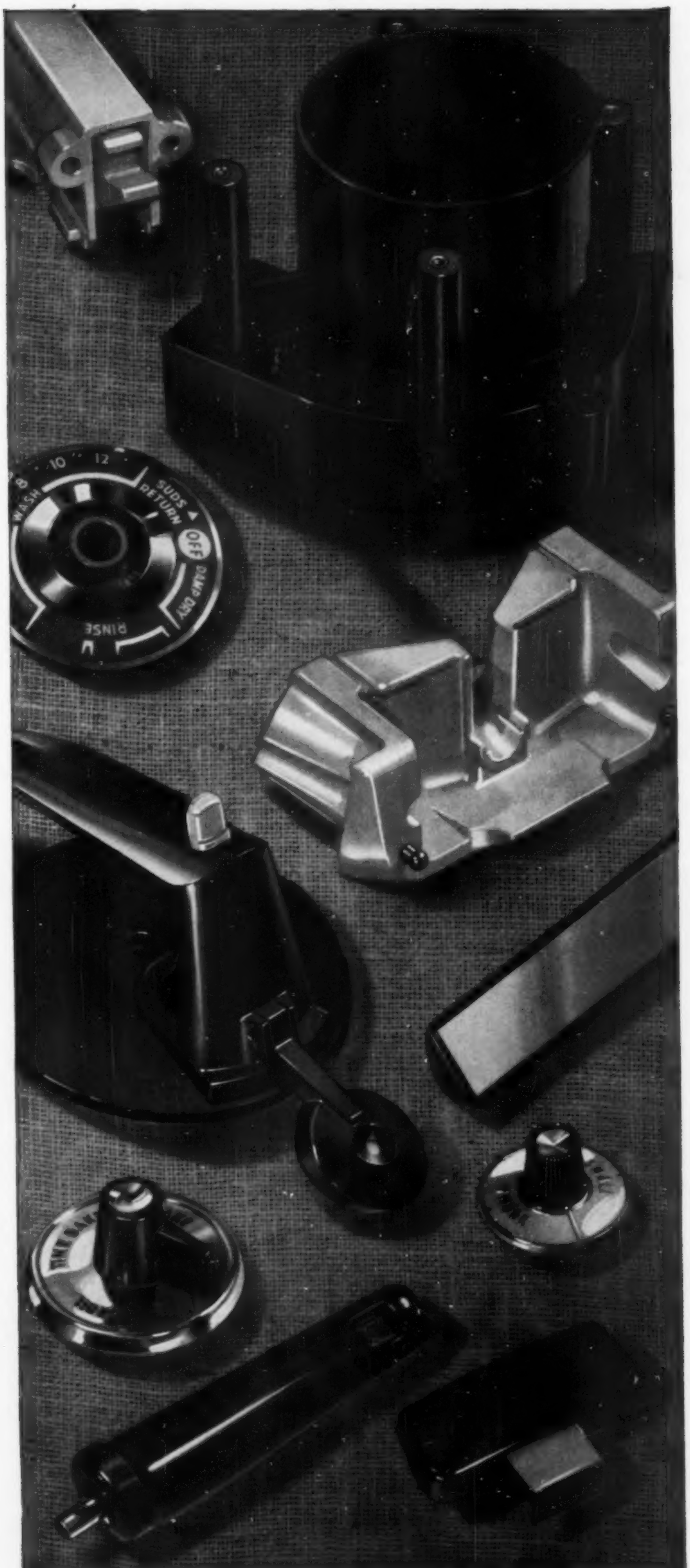
4. No hang back and burning.

5. Complete and rapid purging and change over.

6. Economies of operation due to rapid cycles, lower operating temperature and pressures, reduced down times and low maintenance.—**End**

FIG. 4: Rigid PVC parts below demonstrate the improved quality of injection moldings made on the reciprocating screw type machine. Parts at 1 are shown prior to acetone test. Parts at 2 were molded on a conventional ram-type machine and immersed in acetone for 24 hours. Parts at 3 were molded on the screw-piston type machine and also immersed in acetone for the same length of time.

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Polyethylene film scrap a problem?

Low-cost integrated system that can save up to 20% in raw material cost produces polyethylene pellets from film without extruders, heat, or conventional pelletizers

By Gerald Bamberger*

All processors of polyethylene film scrap face the same problem: the scrap must be converted into a form suitable for direct use by extruders, compounders, injection molders, or blow molders.

For many years this was generally done by re-extruding and pelletizing. There is no doubt that these pellets provide an excellent product. But their manufacture presents two major problems. The first is the high cost of the equipment and machinery required. The second is the fact that the reprocessing operations require critical processing conditions. Thus, to earn an adequate return on his investment, the reprocessor must necessarily charge a relatively high price for these pellets.

A few years ago Sprout, Waldron & Co. Inc., Muncy, Pa., announced the development of a relatively inexpensive, integrated system for producing agglomerates. The system, originally designed for the pelletization of animal feed, was also found to be suitable for pelletizing some plastics in compounders' and molders' plants. The system consists of a chopper and a pellet mill, plus accessory equipment. A number of these installations are now in operation, including one at Interplastics Corp., which produces and markets such agglomerates under the tradename Poly-pellets.

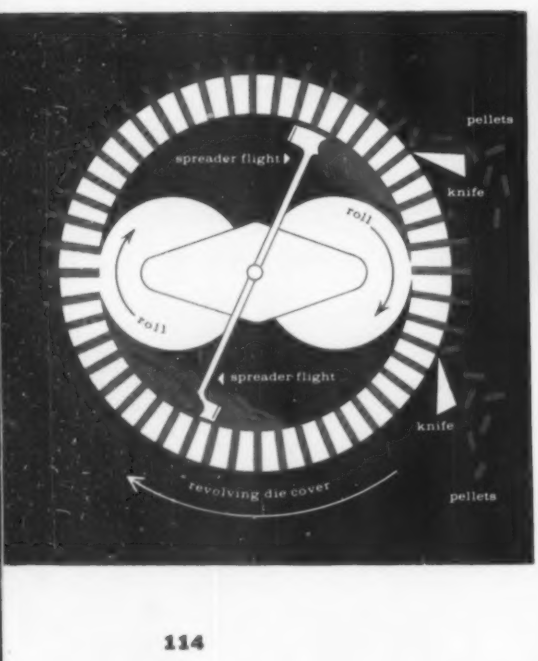
How it works

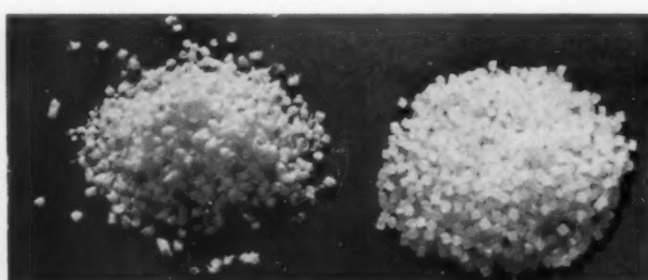
The first step in the process is to cut the polyethylene film scrap into a size suitable for handling in the pellet mill (about ¼ to ½ in. square). It is important not to process films from different resins together. Otherwise feed conditions will not remain essentially constant, and may have to be changed as material properties change. Segregating the material will mean a minimum of specific attention and adjustment to the operating machinery.

The full system is shown schematically at far right. The material is hand fed into the Sprout-Waldron PC-103-1 cast steel, rotary knife cutter. The cutter has an adapter with a wide throat hopper to permit easy feeding of bulky film feeds.

As the material is cut and shredded to size, it is picked up pneumatically by a Sprout-Waldron cyclone products collector, passed through a special hopper into a screw conveyor feeder with a vari- **(To page 186)**

*President, Interplastics Corp., New York, N. Y.

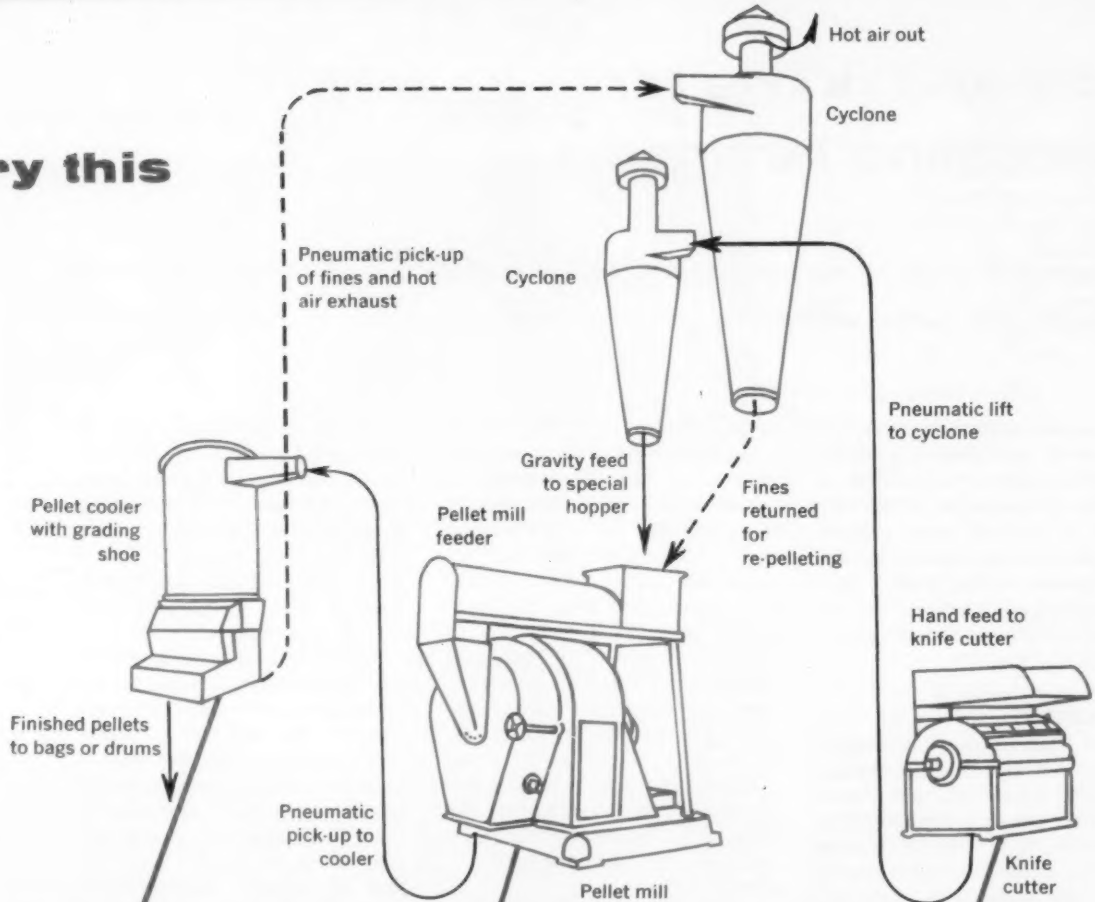


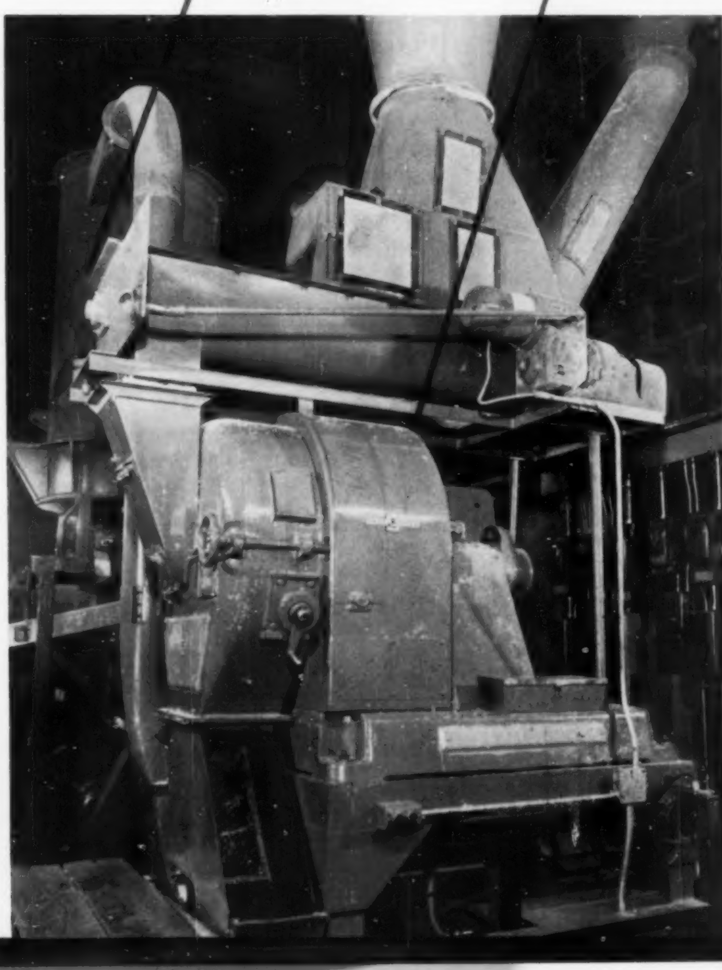


ALTHOUGH not as compact, Poly-pellets (left) approximate the form made by conventional extrusion-cutting process (right).

SCHEMATIC DIAGRAM of the pellet mill shows how the material (in color) is forced through the die and cut to pellet size.

Try this





FIRST STEP in the pelletizing process is to chop the raw film into scraps that are small enough to be pneumatically conveyed to the mill hopper and small enough to be handled in the screw conveyor.

SPROUT-WALDRON pellet mill, showing the discharge port (with screen) which sends fines and Poly-pellets to bagging, fines separation, and recycle system. Also shown is the feed conveyor and central mill inlet. Schematic flow diagram of complete system is at top.

Do's and don'ts for fabricating laminates

An up-to-date report on successful current practices for cloth-, paper-, and glass-reinforced laminates, with special emphasis on proper use of tools

By J. E. Martin*

Experience gained over the past few years in fabricating high-pressure laminates has resulted in a body of knowledge sufficiently grown to establish some general rules on what and what not to do. For purposes of this article, laminates are divided between paper- and cloth-reinforced and glass-reinforced laminates.

PAPER AND CLOTH LAMINATES

Most fabricating operations common to metal working can be performed on paper- and cloth-reinforced plastic laminates. The successful fabrication of plastic laminates does, however, require additional know-how together with an understanding of the characteristics and the limitations. Below are listed the most common fabricating operations, tools required, and the suggested techniques for performing them.

Punching

The term "punching" as used here means the production of laminated parts by blanking, piercing, or shaving or a combination of these operations, with a suitable die mounted in a punch press.

Laminates vary in their degree of punchability and today we find that the only dependable and reproducible test for this property is to punch parts from the laminate in question.

NEMA standards recognize and designate punchability of paper-base laminates by the letter *P* appearing in the grade number; i. e., P, XP, XXP, XXXP, or PC. Canvas and linen base materials are not so designated, and neither are glass base laminates, although most of them are punchable at least to a degree.

Grades. Punch grade laminates can be sub-divided into hot and cold punching grades. In order to produce good clean parts, hot punch grades must be heated while punching. The minimum temperature required will depend on the intricacy of the part, the thickness of the material and the inspection standards. Medium difficult punchings can be made from most materials at room temperature, provided they are less than 1/32 in. thick. Any hot-punch grade will require considerable heat in order to produce parts from 1/8-in. stock.

Recently, cold punch XXXP grades have largely replaced hot punch materials in the electronic industry. The fact that these fabricate well by raising the temperature only a few degrees or not at all makes precision parts possible. Cold punch materials are practically mandatory for the manufacture of printed circuits which have components inserted by automated means.

Design of parts. For years, the rule of thumb used by design men for easy fabrication has been, "No holes closer to each other or to the edge of the part or smaller than the thickness of the material." This is still a good rule for most of the hot punch grades; however, the advent of better fabricating

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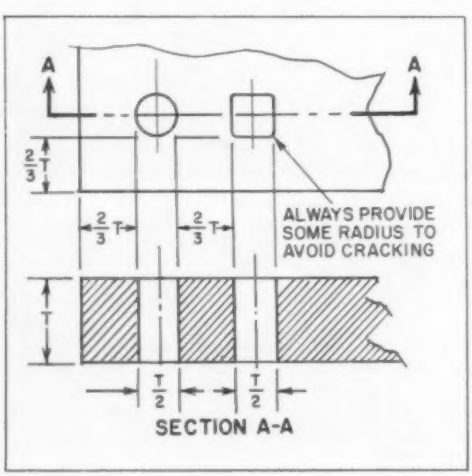


FIG. 1: Illustrating the proper sizing and location of punched holes with respect to each other, and the edge of paper and cloth laminates. Minimum dimensions are shown in terms of **T**, the thickness of the laminate.

Table I: Size of punches for paper and cloth base laminated parts[a]

Material thickness	*Increase punch size for std. tolerance*	*Increase punch for close tolerance*
in.	*in.*	*in.*
1/64	0.002	0.001
1/32	0.003	0.002
3/64	0.004	0.003
1/16	0.005	0.004
5/64	0.007	0.005
3/32	0.008	0.006
7/64	0.011	0.009
1/8	0.012	0.010

[a]These data are not valid for glass reinforced laminates.

Table II: Punching tolerances for punched laminated parts

Material thickness	*Base material*	*Tol. on hole size*	*Tolerances on distance between holes and slots, incl. hot punched*[a] *Up to 2 in.*	*2 in. to 3 in.*	*3 in. to 4 in.*	*4 in. to 5 in.*	*Tolerances for blanked parts, overall dimension*	*Tolerances for shaved parts, overall dimension*
		in.	in.	in.	in.	in.	in.	in.
Up to and incl. 1/16 in.	Paper	0.0015	0.003	0.004	0.005	0.006	0.003	0.002
	Cloth	0.0015	0.002	0.003	0.004	0.005	0.003	0.002
Over 1/16 in. to and incl. 3/32 in.	Paper	0.003	0.005	0.006	0.007	0.008	0.005	0.002
	Cloth	0.002	0.003	0.004	0.005	0.006	0.004	0.002
Over 3/32 in. to and incl. 1/8 in.	Paper	0.005	0.006	0.007	0.008	0.009	0.008	0.002
	Cloth	0.003	0.004	0.005	0.006	0.007	0.006	0.002

[a] Use one-third of tolerance given between holes when punching at or near room temperature.
All tolerances are plus or minus.

cold punch grades has considerably relaxed this rule. Holes down to one half the thickness of the laminate can be punched, although heating above 100° F. is sometimes necessary to reduce breakage of the smaller punches used. See Fig. 1, p. 116.

Holes may be closer to each other or to the edge of the laminate with a good cold punch laminate, but some heating may be required and any distance less than two-thirds the thickness may cause a high reject rate. Always try to design rectangular holes with a corner radius. Even a 1/64-in. radius will help to eliminate a potential source of cracks.

Die construction and dimensions. Because of the tendency of laminates to yield, a pierced hole will always be smaller than the punch which produced it. Similarly, a blanked part will be slightly larger than the die which produced it. Table I, p. 116, shows the amount by which the punch should be oversize.

Close tolerance between punch and die is important for clean punching. For standard tolerance the die hole should be no more than 0.004-in. larger than the punch, giving 0.002 in. clearance all around. For close clearance and clean work decrease the clearance to 0.001 in., making the die 0.002 in. larger than the punch. (See Fig. 2, below.)

For economy of die construction, considerable deviation is sometimes made from recommended punch and die clearances. Such deviation should be tolerated only where very clean, smooth holes are not required and where several thousandths of an inch tolerance on the size of the hole is permitted (See Table II, above, for reasonable tolerances using precision tools).

When blanking to standard tolerances, make the die blanking hole print-size; but for precision work it should be 0.002 in. smaller than the print. The same punch and die clearance as for piercing applies. Make the blanking punch 0.002 in. to 0.004 in. smaller than the die blanking hole, depending on whether close or standard tolerance is required.

When a very clean smooth edge is required, as for punched cams and similar parts subject to edge wear, a shaving stage is incorporated into the die. The shaving portion is made with a 45° rake and is exact print size. It is mounted in the die shoe under the die and shaves 0.015 to 0.020 in. from the edge of the blanked part. This means that the overall size of the blanking die and punch is 0.030 to 0.040 in. larger than print size and the shaving die finishes the rough blanked part to size.

Special instructions for hot-punch laminates. All paper- and cloth-reinforced laminates not specifically designated as cold

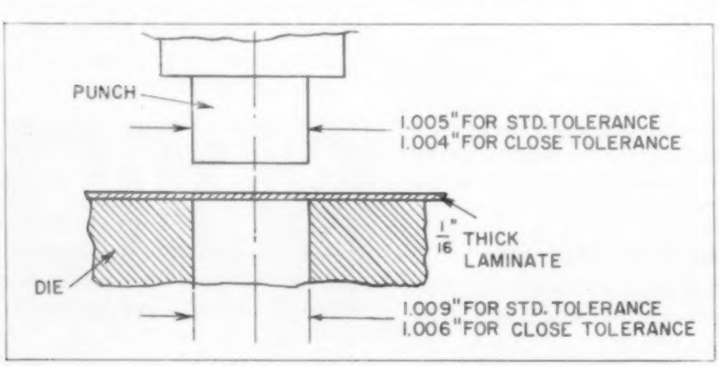


FIG. 2: An example of the proper sizing of a punch and die to pierce a 1/16-in. laminate with a 1 in. diameter hole. For tolerances to be used on other thicknesses of laminate, see Table I, p. 116. Oversize tool allows for snap-back of material.

rode in normal use. In addition, weight verse side for your convenience.

punch grades by the manufacturer will probably need to be hot-punched.

Infra-red ovens and hot plates are the most commonly used heating devices. A typical infra-red oven consists of an open end box a little longer and a little wider than the maximum dimension of the strips to be punched. Infra-red bulbs or strip heaters mounted in reflectors are placed directly over the work in such a way that the heat input can be varied by raising or lowering the heating elements.

For the optimum production rate, infra-red heaters should be adjusted so that the time to punch one strip of material coincides with the time required to heat the next strip. Since the top strip receives most of the heat input of an infra-red oven, the strips may be stacked in the oven. The height of the stack will be determined by the distance between the top of the stack and the heat source, but ordinarily will not exceed about 3 inches.

To use a hot plate, several strips are placed on the plate side-by-side. The operator uses them in rotation, adding a new strip for each one removed.

No specific temperature can be designated for general use. One method which has been used to determine temperature is to find the time it takes a strip to blister under the heat source and then control the operating time to a value between 25 and 75% of the blister time. The exact value will depend on the particular job.

Most hot punch laminates blister at temperatures between 375 and 450° F. They will also become too brittle to punch if held above 300° F. for prolonged periods, and, for this reason, laminates are always removed from the oven during lunch periods, coffee breaks, or other punch-press downtime.

Some embrittlement may occur at temperatures below 250° F., but a well formulated, fully cured phenolic board should not be affected appreciably by a 1- to 2-hr. exposure below this temperature.

Crayons and inks which melt at a precise temperature are very convenient tools for determining the temperature of the work. Electrical parts marked with these

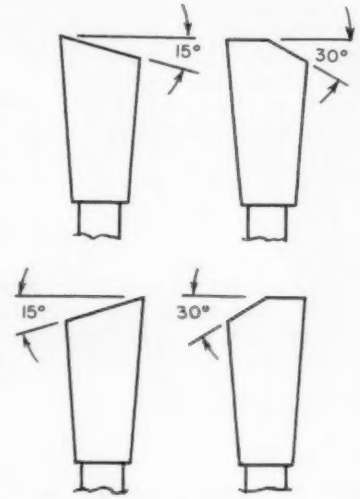


FIG. 3: Showing two commonly used saw teeth designs for paper and cloth laminates. At left, two successive teeth on a 15° alternate bevel saw. Right, two successive teeth on 30° alternate corner relieved (AC-30) saw.

materials should be carefully cleaned or scraped as the residue may affect the electrical properties of the finished part.

Temperature control is important in precision work where print tolerances are close, because the thermal expansion of the material will affect the dimensions of the finished part. With the exception of a few special grades which are cross-laminated, laminates are anisotropic with respect to thermal expansion.

Typically, a hot punch paper- or cloth-phenolic will expand from 1.7×10^{-5} to 3.6×10^{-5} in./in./°F. with the grain direction of the material and about 1½ that much in the other direction. For example, let us blank a square from a laminate having a coefficient of thermal expansion of 2.2×10^{-5} in./in./°F. with the grain and 3.1×10^{-5} in./in./°F. across the grain. Let us heat it to 320° F. and blank it in a die which gives a perfect 3 in. sq. at 70° F. The contraction with the grain upon cooling the blanked part will then be, 0.000022 in./in./°F. $\times$ (320 −70)°F $\times$ 3 in. or 0.0165 inch.

The crossgrain contraction will be, 0.000031 in./in./°F. $\times$ (320 −70)°F $\times$ 3 in. or 0.0233 inch. The finished "3-in. sq." will be 2.983 $\times$ 2.977 at 70° F. if the yield of the material is neglected.

For close tolerance parts, the design engineer should factor in the manufacturer's data on coefficient of thermal expansion and should also realize that the precision of these data is usually not better than ±25 percent.

Circular sawing

Steel saws. Good results are obtained with steel saws running at rim speeds of 7500 to 10,000 ft./min. The number of teeth should vary according to the thickness of the laminate. Use saws with 10 to 12 teeth/in. of diameter for laminates up to ¼-in. thick. For thicknesses of ¼ to 1 in., 6 to 8 teeth/in. is satisfactory and 4 teeth/in. or coarser should be used for laminates thicker than 1 inch.

Steel saws should have some alternate set; and for very smooth cuts on thin stock hollow ground blades with 15° alternate top bevel are especially suggested as shown in Fig. 3, left.

Carbide tipped saws: Blades with carbide tips will give 40 to 50 times longer service than steel saws and will give smoother top and bottom edges over a longer cutting life.

Two tooth forms are suggested. For materials less than ½ in. thick or where good bottom edge cuts are required a 15° alternate top bevel with a tooth pitch of less than 7/16 in. should be used.

The other shape which will not give as clean a bottom cut, but which will run longer between sharpening because it is a stronger tooth form is known as the AC-30 (alternating corner 30 degree relief). This is a flat top or swage tooth with alternate corners relieved (Fig. 3).

A radial hook of 7° to 12° should be provided for table saws or other machines making a conventional cut; however, zero radial hook is recommended for saws with a climb cut action such as some of the radial arm types.

In order to obtain maximum use between sharpenings every source of vibration either in the saw or the material being cut must be eliminated. The blade should run true to within 0.005 in. run out and the arbor and collars must be in exact alignment with the blade;

a power feed mechanism will help to reduce vibration, but it is not essential.

Reduced susceptibility to vibration is probably the reason that heavy kerf blades stay sharp longer than thin ones. Where thin blades must be used, it will help to use stiffening collars of the largest diameter commensurate with the depth of cut.

Bandsawing. A tempered steel 20-gage (0.037 in.) saw with staggered teeth is recommended. Use a 3- to 5-pitch saw for thick material and 6 to 7 for thin sheets. The set should be medium for straight work and heavy for circular cuts. A blade 1 to 1¼ in. wide is satisfactory for straight cuts, but for circles down to a 2 in. diameter use a ½-in. blade. A ¼- or ⅜-in. blade is needed for small circles and scrolls.

The speed may vary from 2000 ft./min. for heavy work up to 6000 ft./min. for 1/32-in. stock. Feed the material slowly enough for free cutting and do not force the saw.

Drilling and tapping

High speed drills having the lip backed off for plenty of clearance are satisfactory for limited production. Drills tipped with Carboloy[1] cemented carbide should be used for large production runs.

The most generally satisfactory drill has a rather steep twist, and a thin web with highly polished flutes. Such drills are known to the fabricating trade as Bakelite Drills (See Fig. 4, below).

Operate drills at the highest speed possible without burning. For ¼ in. this will be from 2000 to 3000 r.p.m. and can go up to 20,000 r.p.m. for a 1/32-in. Carboloy tipped drill.

Because of the resiliency of the laminate drills need to be 0.002 to 0.004 in. oversize for normal hole size tolerance (See Table III, above). For very close tolerance, a reaming operation is indicated. Reverse spiral reamers work best, but any standard reamer will do a fair to good job.

Tapping is best done with chrome plated and ground taps. Taps should be 0.003 to 0.004 in. larger than for metal. Use about same feed and speed as for brass. An oil emulsion for lubrication and cleaning chips is helpful.

When drilling or tapping parallel to the laminations, always clamp the work between two supports to prevent splitting. This is not necessary when working perpendicular to the lamination, although a backup to prevent chipping makes a cleaner hole. A pilot hole is usually helpful in drilling large holes.

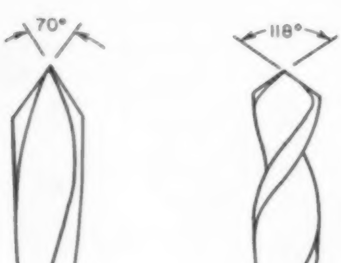


FIG. 4: Two sketches of the types of drills used for laminates. At left, the Bakelite drill with a 70° point is used for paper and cloth laminates. A high spiral drill with a 118° point, found best for glass reinforced laminates, is shown at the right.

Turning and screw machining

Laminates can be turned with high-speed steel tools at about 400 surface ft./min.; however, with Carboloy-tipped tools, the speed can be doubled or even tripled. Very sharp round nose tools with 30° to 60° clearance angle and a slight negative rake are recommended. Fairly coarse cuts can be taken leaving 0.010 to 0.015 in. for a smooth final cut.

For production runs on automatic screw machines, Carboloy tools with tool steel cams are suggested, but for shorter runs high speed tools and laminated cams may be used.

Milling

Because of the laminated structure, climb or down milling is always used to prevent any tendency toward delamination. The feed and speed are similar to what is used for brass. Cutters should have a negative rake of about 10°. When milling across the laminations, it is important to clamp a back-up to the work to prevent separation of the last lamination or two by the cutter. This is also important when milling a groove on the edge of a laminated board, as the cutter will exert a force similar to that of a drill entering parallel to the lamination.

[1] General Electric trademark.

Table III: Tolerances on drilled hole diameters

Drill diameter	Tolerance (all minus)
in.	in.
3/32 to ¼	0.003
Above ¼ to 1	0.004
Above 1 to 1½	0.005
Over 1½	0.007

Shearing

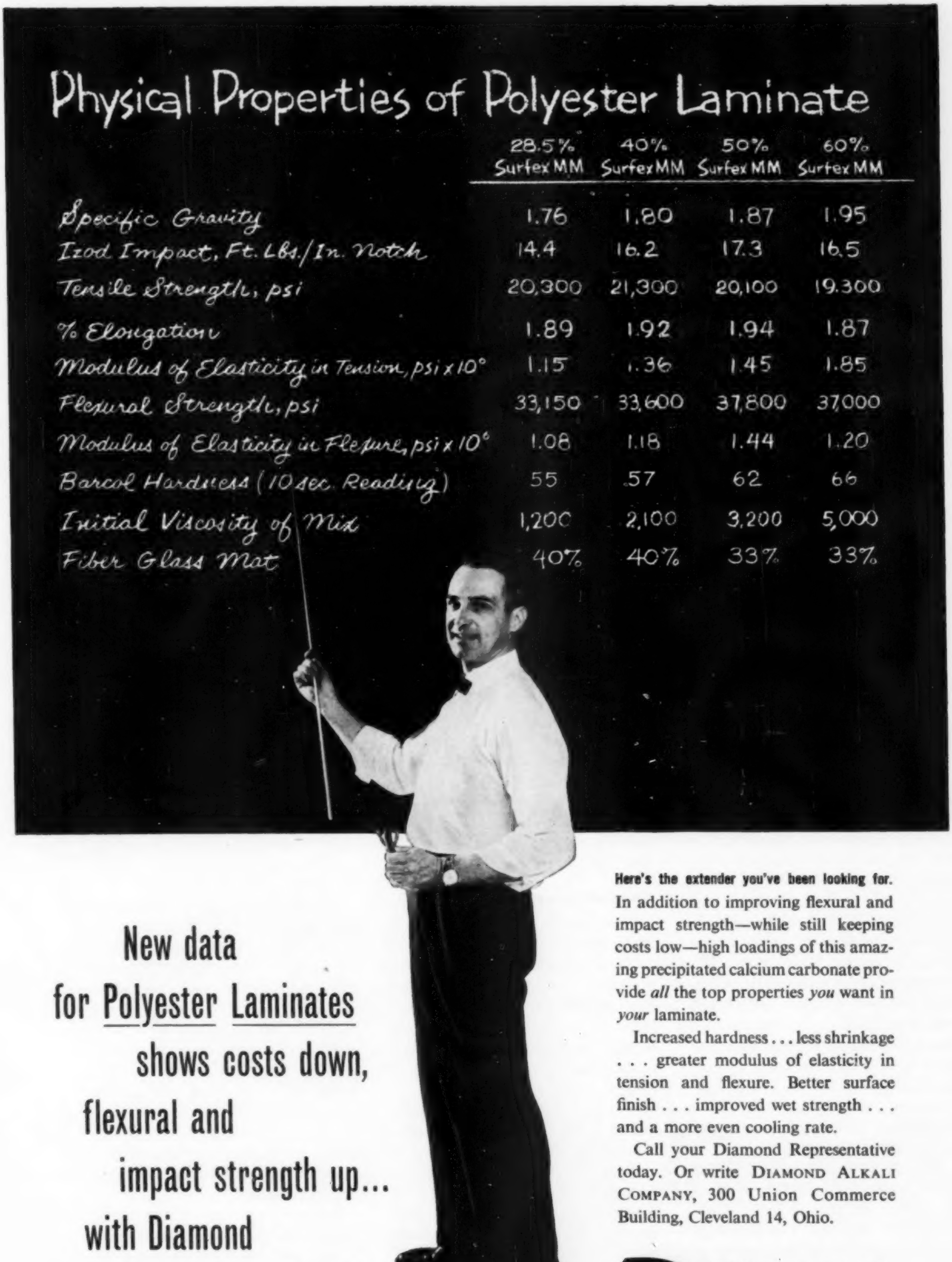
Shearing is accomplished with a power operated guillotine shear of the same general type used to shear metal, the principal difference being that the blade clearance is set much closer for plastic than for metal.

Blades are sharpened square, they are fairly heavy, and are mounted sturdily to eliminate the possibility of blade interference which might be caused by bowing due to thermal expansion during hot shearing. Too much clearance between blades causes a rough sheared edge and a newly sharpened shear should be set at 0.001 in. clearance or even less, if it is at all possible.

The moving blade is set at an angle of around 1° with the stationary blade. Although this is not critical for some applications, too great an angle will increase the frequency of featherlike cracks on the cut off piece and a very small angle will increase the power requirement of the shear.

Most laminates can be sheared up to ⅛ in. thickness; however, many of them need to be heated to prevent feathering and breakout along the sheared edge.

A satisfactory method of heating is to assemble a bank of infrared strip heaters about the size of the sheets to be sheared. This



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heater unit is suspended on a chain block above the stack of sheets. By adjusting the distance of the heaters from the top sheet in the stock, the time required to heat the top sheet may be made to coincide with the time used to shear the preceding sheet.

If very narrow strips are being sheared, the sheet may cool excessively in the shear, making the last strips rather rough. In this particular case it will save reheating time to add a hotplate to the bed of the shear.

GLASS-REINFORCED LAMINATES

In order to fabricate glass reinforced laminates, it is essential to understand not only their nature but also the materials from which they are made.

The resins used to bond glass cloth reinforcement for high pressure laminates are epoxy, melamine, phenolic, and silicone. Their ability to wet the glass fibers and form a strong interlaminar bond is generally in the order named above. This means that while it may be possible to drill or to mill across laminations of an NEMA G-10 glass-epoxy laminate without a backup, the same technique applied to glass silicone will almost certainly result in delamination of the last layer or two.

Table IV, above, shows the grades of glass-reinforced laminate that are recognized by NEMA Standards. Note that in the case of the glass-silicone and glass-phenolic laminates, two grades of each are recognized. Grades G-2 and G-6 are reinforced with glass cloth woven from a staple fiber yarn. The countless short fiber ends which give the cloth its fuzzy appearance also contribute to the interlaminar bond. Therefore, Grades G-2 and G-6 are a little less likely to peel apart than Grades G-3 and G-7; however, the latter two have somewhat higher flexural and tensile strength.

The epoxy resin used in NEMA G-10 laminates is different from the others in that it softens appreciably at high temperature even though it is classed as a thermosetting material. To the fabricator this means that excessive heat developed during a drilling or sawing operation can cause tools to become resin fouled. The newer G-11 high-temperature glass-epoxy is in general much better in this respect although most G-11 laminates dull tools more rapidly than G-10.

Table IV: NEMA grades of glass reinforced laminates

NEMA grade	*Resin*	*Cloth*
G-2	Phenolic	Staple fiber
G-3	Phenolic	Continuous filament
G-5	Melamine	Continuous filament
G-6	Silicone	Staple fiber
G-7	Silicone	Continuous filament
G-10	Epoxy	Continuous filament
G-11	Epoxy	Continuous filament
GPO-1	Polyester	Random fiber mat

This discussion of materials would not be complete without mention of NEMA Grade GPO-1, a polyester laminate reinforced with random fiber glass mat. This is not strictly speaking a true high-pressure laminate although the polyester bonds well to the glass, the resin does not soften with heat, and the same general fabricating techniques apply to polyester as to the other grades that have been mentioned.

General considerations

The abrasive nature of glass dulls steel tools rapidly and so carbide tipped or diamond tools are always recommended. When dry machining operations are carried out, an efficient dust collector is necessary as the abrasive dust is very hard on machinery and is also irritating.

Wet machining is easier to do, partly because it provides some lubrication and partly because it cools the work and the tools. Aqueous systems, especially if they contain a detergent or wetting agent, may degrade the electrical properties of the material and for critical applications finished parts should be well washed with pure water and dried in a forced air oven for at least an hour or two at 130° C. before packing or storing.

Because some grades delaminate easily, the work must be clamped between supports for any milling or drilling operation performed on the edge of a laminated sheet. For the same reason a laminated tube should always be mounted in a lathe so that the direction of rotation is kept the same as the one used when the tube was rolled.

Punching

All glass laminates are punched at ambient conditions. There are no hot punch grades. This means that in designing dies the coefficient of thermal expansion of the material may be neglected.

The tendency of the laminate to yield, causing pierced holes to be smaller than the punch and blanked parts to be larger than the die, is markedly less than with paper and cloth reinforced laminate compositions.

In general, punches and dies should be oversize by about 3% of the material thickness; i.e., a punch for ⅛ in. material would be about 0.004 in. oversize instead of the 0.010 to 0.012 in. recommended for paper or cloth (cellulosic) based laminates.

To minimize any tendency for the top or bottom sheet to delaminate while being pierced, clearance between plumb and die as well as between punch and stripper should be held to a maximum of 0.002 inch.

For the same reason, compound dies with spring loaded strippers are preferred over those with box strippers, as their design helps to hold the material firmly in place while the punches enter and are then withdrawn.

For short runs, tool steel dies may be used but for production a hard chrome plate on both punch and die will pay for itself several times in reduced tool wear. Very large production will probably justify the expense of carbide tipped punches.

Because of the high shear strength of glass-reinforced laminates, pierced holes smaller in diameter than the material thickness are likely to be the cause of excessive punch breakage. The force required to **(To page 188)**

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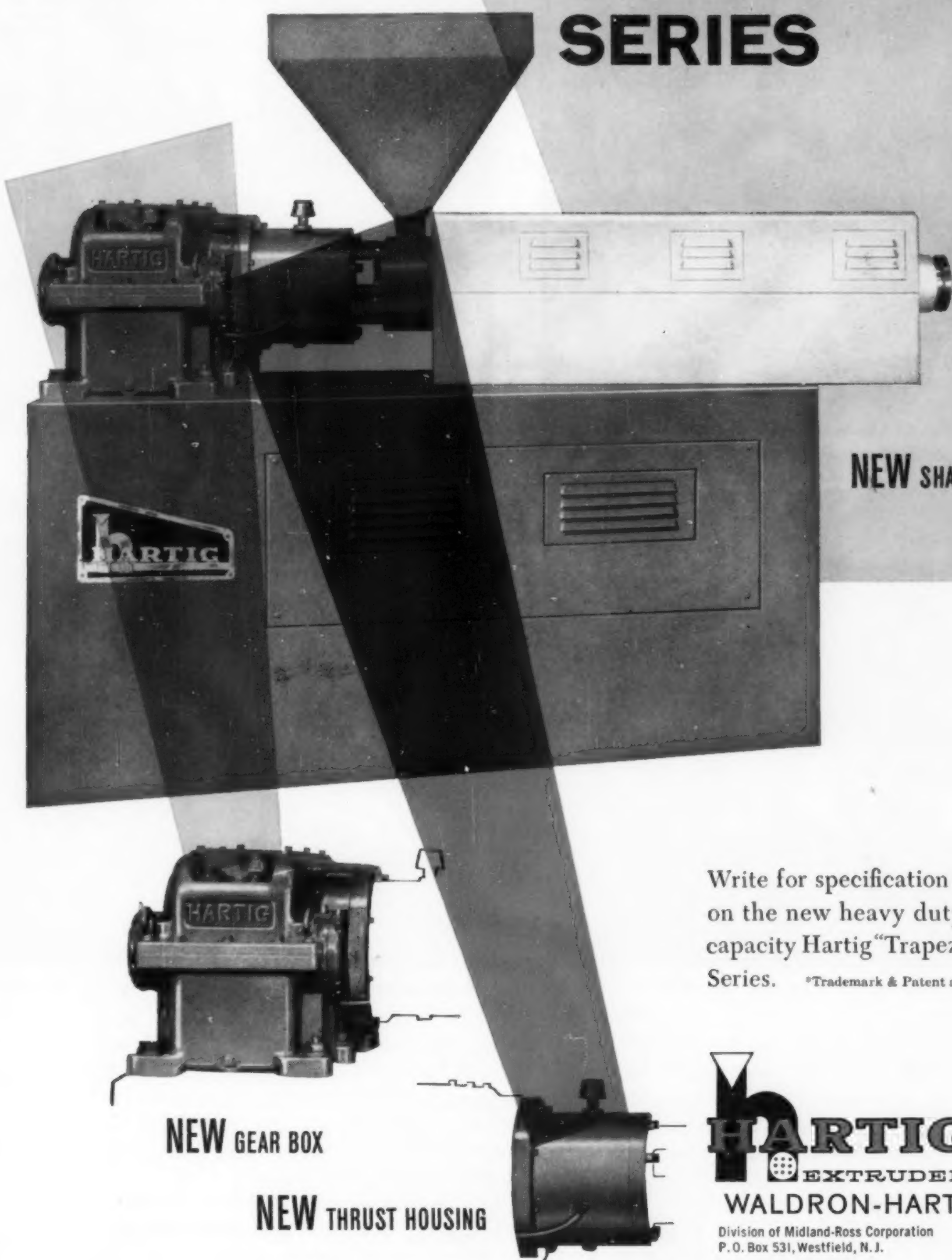

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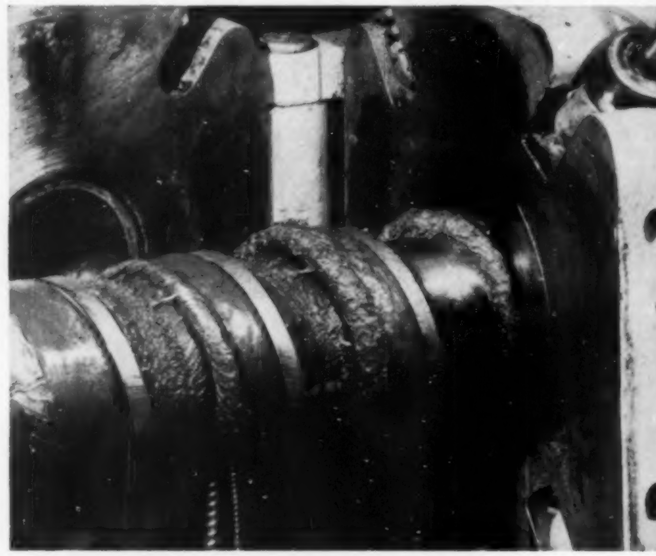

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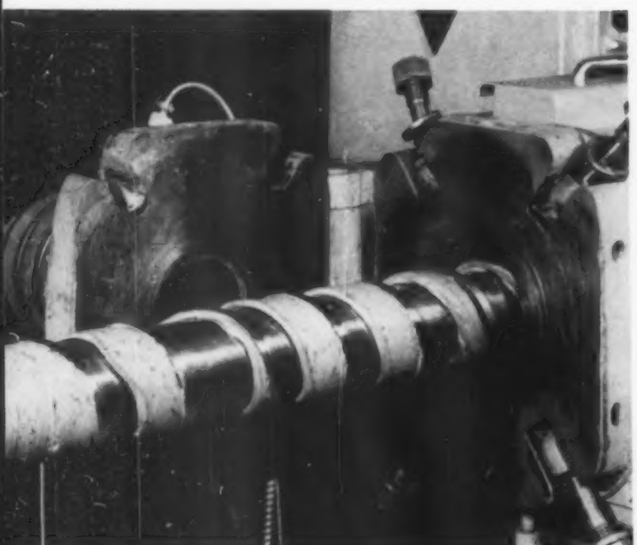

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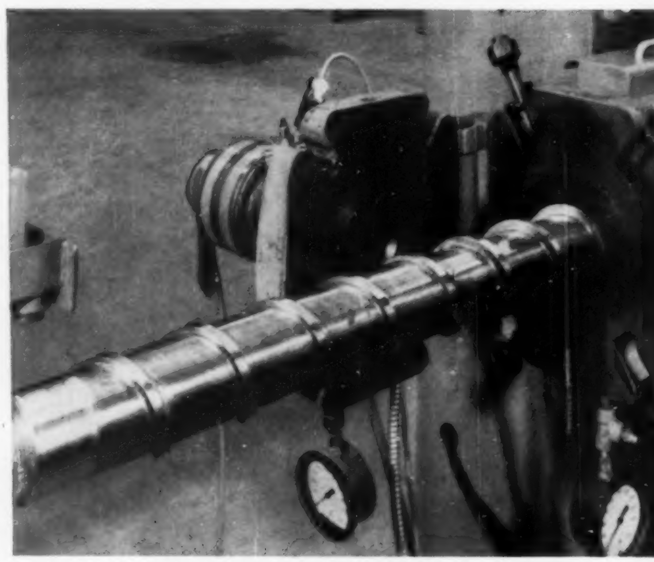

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General formula for creep and rupture stresses in plastics

By S. Goldfein†

The parameter K in the following general formula may be usefully employed to predict rupture and creep properties of plastics materials under varying conditions of time and temperature:

$$K = \frac{T_0\,T}{T_0 - T}(20 + \log t)$$

where T_0 is the zero strength temperature, T the operating temperature, and t the time. Samples of widely different plastics materials, such as glass-reinforced plastics, polyethylene, and polyformaldehyde, were secured and tested at low and elevated temperatures. Data from these tests were plotted against the parameter K. The master curves so obtained were then used to predict rupture and creep properties for periods of time from 0.01 sec. to 40,000 hours. High accuracy was obtained by this method for the three plastics investigated.

The Arrhenius equation (1)[1]

$$\frac{d \ln k}{dT} = \frac{E}{RT^2} \qquad \text{Eq. 1}$$

where k is the reaction velocity constant, T the absolute temperature, E the energy of activation of the process, and R the gas constant, has found widespread application to such materials as plastics, metals, and ceramics, and processes such as chemical reactions, electrical phenomena, creep, rupture, etc. Integrating Equation 1:

$$\ln \frac{k_0}{k} = \frac{E}{R}\left(\frac{1}{T} - \frac{1}{T_0}\right) \qquad \text{Eq. 2}$$

is obtained, where T_0 and k_0 are upper limits of the integration process. If T_0 is considered to be the melting point, boiling point, decomposition temperature, or temperature at which the material has no strength, k_0 is designated to represent the rupture rate at that temperature.

The activation energy, E, although not a constant, does not vary appreciably with temperature. Assuming E to be constant in the temperature ranges to be investigated, Eq. 2 may be rearranged with all the constants incorporated in K as follows:

$$K = \frac{T\,T_0}{T_0 - T}(\log k_0 - \log k) \qquad \text{Eq. 3}$$

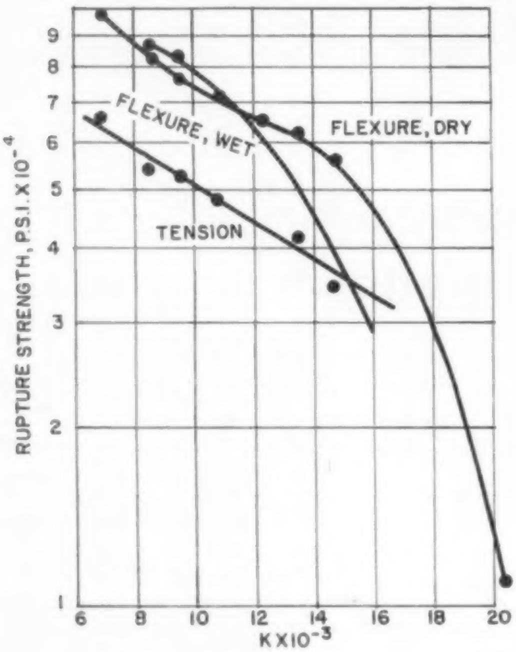
In order to further simplify Equation 3, a constant may be substituted for either T_0 or $\log k_0$. It is preferable that a constant be given for $\log k_0$, since it appeared to be more difficult to determine its value than to determine T_0. If rupture is defined as the separation and breaking apart of atoms and molecules, the maximum possible rupture rate, k_0, will then be the one at which all the atoms or molecules in a mole of the material separate from each other at the same time. Since there are 6.02×10^{23} molecules in a gaseous mole (Avogadro's number), the maximum possible rupture rate will be 6.02×10^{23} molecules per unit time. The value of $\log k_0$ would be 22.78, assuming initial perfect parallel alignment or crystallinity. In an amorphous polymer or one with much branching and little crystallinity, there may be only a very small percentage of such perfection. If there were contacts or bonds between 1% of the atoms bonding the molecules, $\log k_0$ would be 20.78; at 0.1% $\log k_0$ would be 19.78. It is thus evident that a large change in the number of bonds to be fractured changes $\log k_0$ only slightly. In this work, a value of 20 will be assumed for $\log k_0$, not only because it is probably a mean value, but because it has given good results in the past (2-5). With this assumption, Equation 3 becomes:

$$K = \frac{T\,T_0}{T_0 - T}(20 - \log k) \qquad \text{Eq. 4}$$

A relationship between $\log k$ and time t is required to complete the parameter. This may be done by consideration of the fracture and creep processes as a chemical reaction for purposes of handling the problem mathematically. It is difficult to describe a previously considered physical process as a chemical reaction, yet it is not impossible. For example, sanding the surface of a thermoset phenolic, epoxy, or polyester resin

*Reg. U. S. Pat. Off.
†Chief, Plastics Section, Materials Branch, USAERDL, Fort Belvoir, Va.
[1]Numbers in parentheses link to references at end of article, p. 200.
Adapted from Materials Branch Report No. 2409-17.

FIG. 1: Master rupture curves for laminate made with Epon 828 resin and 181 Glass Cloth, Volan A finish (See Table I).



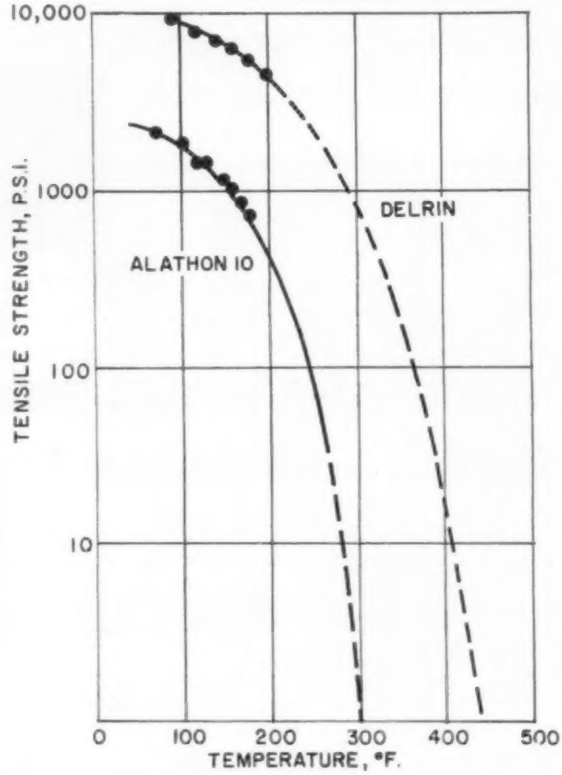


FIG. 2: Tensile strength versus temperature curves for polyethylene and polyformaldehyde.

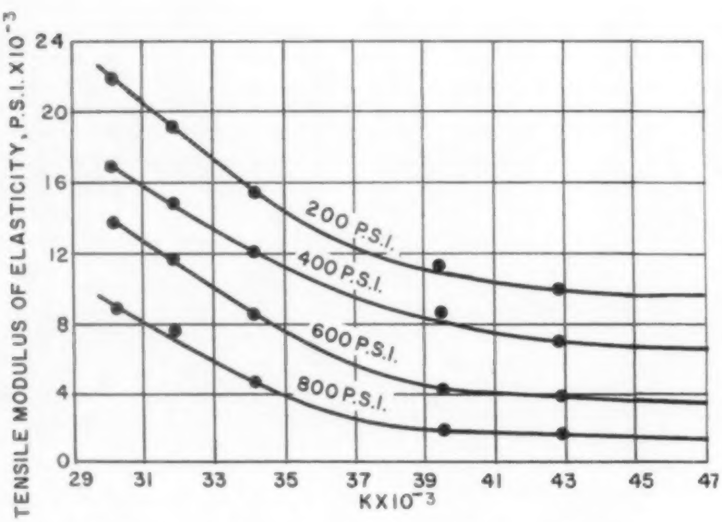


FIG. 3: Master modulus curves for Alathon 10 PE (See Table III.).

will greatly improve its ability to be bonded by an adhesive of the chemically reactive type such as an epoxy. The chief reason for this condition is that since the thermoset resin is one huge network or molecule of chemically bonded atoms, any mechanical action or abrasion is in effect a chemical reaction. Sanding a thermoplastic material in this manner will not improve its adhesion. Schmidt and Marlies (6) expressed it very well in another fashion: "At first thought, physical processes such as the flow of a liquid seem quite different from chemical reactions. However, from a molecular point of view, they are similar. Thus, in chemical reactions, the atoms in one equilibrium position, i.e., a chemical compound, surmount an energy barrier and get into a new equilibrium position, i.e., a new chemical compound; and in the flow of a liquid under a stress gradient, the molecules in one equilibrium position similarly surmount an energy barrier and get into new positions, causing the liquid to flow. The change in rate of flow with temperature is given by the Arrhenius equation. As temperature falls the liquid flows more slowly because fewer molecules have a sufficient energy to surmount the energy barrier and move to more stable positions."

If rupture and creep are considered as a chemical reaction, then they are probably zero order reactions, since both before and after rupture the physical and chemical properties are practically the same. In a zero-order reaction

$$k = \frac{x}{t} \qquad \text{Eq. 5}$$

where x is the concentration of the material undergoing creep (7). Since all of the material is undergoing creep or rupture probably

by chain-chain slippage, $x = 1$ and

$$\log k = \log x - \log t = -\log t \quad \text{Eq. 6}$$

Equation 4 then becomes:

$$K = \frac{T\,T_o}{T_o - T}\,(20 + \log t) \quad \text{Eq. 7}$$

If the differences between T and T_o are large as in glass-reinforced plastics, the value of the term $T_o/T_o\text{-}T$ approaches one and Eq. 7 condenses to:

$$K = T\,(20 + \log t) \quad \text{Eq. 8}$$

which is the Larson and Miller parameter (8). If these differences are small, as in thermoplastics, the value of the term will be large and Eq. 7 must be used.

Equation 8 has been found to characterize many alloys, both ferrous and nonferrous (8), and glass-fiber-reinforced plastics (2-5). Other alloys gave good results only when $\log k_o$ had values other than 20, in the range

Table I: Static rupture strengths of epoxy glass-cloth laminate[a] at various temperatures

Temperature		K[b]	Tensile strength[c]	Flexural strength[d]	
				Dry	Wet
°F.	°F. abs.		p.s.i.	p.s.i.	p.s.i.
—55	405	6,930	66,200	98,100	—
+32	492	8,650	53,700	82,900	—
34	494	8,670	—	—	86,800
76	536	9,560	52,100	76,500	82,600
137	597	10,900	47,600	71,600	71,200
198	658	12,250	—	—	61,500
200	660	12,300	45,900	64,700	—
250	710	13,510	41,500[e]	61,800[e]	—
300	760	14,750	34,500[e]	55,500[e]	—
500	960	20,200	—	11,000[f]	—

[a] Fabricated by Shell Chemical Co. to be identical with one in Table II, but differed slightly in strength properties (See footnotes in Table II, below.).

[b] $K = \frac{T_oT}{T_o - T}(20 + \log t)$, $t = 10^{-6}$ hr., $T_o = 3360°$ F. abs.

[c] Average of 2 to 3 specimens.

[d] Average of 5 to 6 specimens.

[e] Determined by New York Naval Shipyard

[f] Data from Shell Chemical Co.

Table II: Long-term rupture data at 73°F. for epoxy glass-cloth laminate[a]

Property	Time	K[b]	Stress from master rupture curve (Fig. 1)	Calculated corrected stress	Observed stress[c]	Difference between obs. & calc. stress[f]
	hr.		p.s.i.	p.s.i.	p.s.i.	%
Flexural strength, dry[d]	1	12,660	63,500	58,900	57,000	—3.3
	10	13,300	61,500	57,100	54,000	—5.7
	1,000	13,930	59,100	54,800	51,000	—7.5
	1,000	14,570	56,200	52,200	48,000	—8.8
	10,000	15,200	52,200	48,400	44,500	—9.0
	20,000	15,350	51,200	47,500	43,800	—8.7
	40,000	15,600	49,500	45,900	43,000	—6.7
Flexural strength, wet[d]	1	12,660	57,500	53,400	54,500	+2.0
	10	13,300	52,000	48,300	50,000	+3.4
	100	13,930	45,500	42,200	45,000	+6.2
	1,000	14,570	40,300	37,400	40,500	+7.7
	10,000	15,200	35,000	32,500	36,000	+9.7
	20,000	15,350	33,700	31,300	34,000	+7.9
	40,000	15,600	31,500	29,200	32,800	+11.0
Tensile strength, dry[e]	1	12,660	42,000	43,500	43,000	—1.2
	10	13,300	40,300	41,800	42,000	+0.5
	100	13,930	38,500	39,900	41,000	+2.7
	1,000	14,570	36,800	38,100	39,000	+2.3
	10,000	15,200	35,200	36,500	37,500	+2.7
	20,000	15,350	34,800	36,100	37,200	+3.0
	40,000	15,600	34,100	35,300	36,250	+2.6

[a] Fabricated by Shell Chemical Co., using Epon 828 cured with metaphenylenediamine reinforced with style 181 glass cloth finished with Volan A.

[b] $K = \frac{T_oT}{T_o - T}(20 + \log t)$, $t = 10^{-5}$ hr., $T_o = 3360°$ F. abs.

[c] These data were taken from a stress-time curve based on data obtained by the Forest Products Laboratory.

[d] Static flexural strength is 71,200 p.s.i., compared to 76,700 p.s.i. at 73° F. for laminate supplied to ERDL and used to obtain data plotted in master rupture curve. Correction factor is 71,200/76,700 = 0.928.

[e] Static tensile strength is 54,100 p.s.i., compared to 52,200 p.s.i. at 73° F. for laminate supplied to ERDL and used to obtain data plotted in master rupture curve. Correction factor is 54,100/52,000 = 1.036.

[f] % Difference $= \frac{\text{Obs.} - \text{Calc}}{\text{Obs.}}\ 100$

15 to 23 (8). Thermoplastics were found to give agreement only in the sub-zero range and short micro-second time periods (4).

Experimental

Three materials of widely different properties were chosen for investigation: a glass-fiber-reinforced epoxy (Epon[2] 828) laminate representing a strong, hard, thermoset material; Delrin,[3] a recently developed rigid acetal thermoplastic (polyformaldehyde) having a high heat distortion temperature; and Alathon[3] 10 polyethylene, representing a weak, low heat distortion, elastomeric type plastic.

Master rupture curve: Since t in Eq. 7 represents the time during which the material is under a constant load rather than a gradually increasing one, the time to ultimate failure measured during the static test cannot be used in the parameter without excessive error. A steady-load-time equivalent, i.e., the time to failure if the ultimate stress determined in the static test were applied instantaneously to the specimen, is

[2]Registered trademark of Shell Chemical Co.

[3]Registered trademark of E. I. du Pont de Nemours & Co. Inc.

Table III: Tensile moduli of elasticity of polyethylene[a]

Temperature		K^b	Tensile modulus of elasticity[c] 200 p.s.i. stress	400 p.s.i. stress	600 p.s.i. stress	800 p.s.i. stress	Tensile strength
°F.	°F. abs.		p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.
75	535	27,300	29,800	24,000	20,000	14,500	2,180
92	552	30,200	21,900	16,900	13,800	8,900	2,020
100	460	31,900	19,000	14,900	11,800	7,700	1,860
110	570	34,200	16,000	12,100	8,540	4,940	1,680
120	580	36,600	12,300	9,490	6,460	2,680	1,490
130	590	39,500	11,200	8,470	4,150	1,830	1,450
140	600	42,800	9,600	6,690	3,790	1,630	1,230

[a]Alathon 10, E. I. du Pont de Nemours & Co. Inc.
[b]$K = \frac{T_oT}{T_o - T}(20 + \log t)$, $t = 10^{-5}$ hr., $T_o = 760°$ F. abs.
[c]Tangent modulus at stress level specified.

Table IV: Long-term tensile creep data for polyethylene[a] at 85°F.

Stress level	Time	K^b	E tensile[c] (from Fig. 3)	Creep calculated[d]	Creep observed[e]	Difference between obs. and calc. creep[f]
p.s.i.	hr.		p.s.i.	%	%	%
200	100	42,400	9,850	0.0203	0.017	—19.4
	300	43,300	9,750	0.0205	0.022	+ 6.8
	600	43,800	9,630	0.0208	0.0203	— 2.5
400	100	42,400	7,000	0.0571	0.046	—24.1
	300	43,300	6,800	0.0588	0.056	— 5
	500	43,700	6,750	0.0593	0.060	+ 1.2
	1,000	44,300	6,700	0.0597	0.060	+ 0.5
600	100	42,400	3,800	0.158	0.135	—17
	300	43,300	3,650	0.165	0.142	—16.2
	600	43,800	3,600	0.167	0.151	—10.6
	1,000	44,300	3,500	0.172	0.160	— 7.5
	2,000	44,850	3,400	0.177	0.170	— 4.1
800	100	42,400	1,650	0.485	0.439	—10.5
	500	43,700	1,600	0.500	0.472	— 5.9
	750	44,000	1,580	0.505	0.488	— 3.5
	1,000	44,300	1,550	0.515	0.500	— 3.0
	2,000	44,850	1,500	0.533	0.530	— 0.6
	3,000	45,150	1,480	0.540	0.545	+ 0.9
	4,000	45,500	1,430	0.560	0.550	— 1.8

[a]Alathon 10, E. I. du Pont de Nemours & Co.
[b]$K = \frac{T_oT}{T_o - T}(20 + \log t)$, $t = 10^{-5}$ hr., $T_o = 760°$ F. abs.
[c]Tangent modulus of elasticity at stress level specified.
[d]Creep calculated by dividing stress by tangent modulus.
[e]Data supplied by E. I. du Pont de Nemours & Co. Inc.
[f]$\%\ \text{Difference} = \frac{\text{Obs.} - \text{Calc.}}{\text{Obs.}}\ 100.$

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Table V: Tensile strength of Delrin[a]

Temperature		K^b	Ultimate tensile strength
°F.	°F. abs.		p.s.i.
92	552	21,400	9,350
120	580	24,400	8,050
140	600	27,000	7,140
160	620	29,900	6,400
180	640	33,200	5,430
200	660	37,100	4,650

[a]Polymerized acetal resin (polyformaldehyde) produced by E. I. du Pont de Nemours & Co. Inc.
[b]$K = \frac{T_o T}{T_o - T}(20 + \log t)$, $t = 10^{-5}$ hr., $T_o = 900°$ F. abs.

Table VI: Long-term tensile strength of Delrin at 73°F.

Time	K^b	Tensile stress: Calculated (from Fig. 5)	Tensile stress: Observed[a]	Difference between obs. and calc. tensile stress[b]
hr.		p.s.i.	p.s.i.	%
10	27,410	7,130	7,800	+8.6
100	28,800	6,700	7,000	+4.3
1,000	30,100	6,320	6,100	—3.6
10,000	31,400	5,950	5,600	—6.3

[a]Data supplied by E. I. du Pont de Nemours & Co. Inc.
[b]$\%\ \text{Difference} = \frac{\text{Obs.} - \text{Calc.}}{\text{Obs.}} 100$

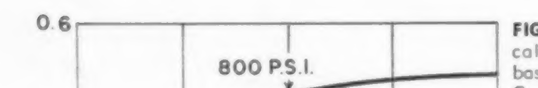
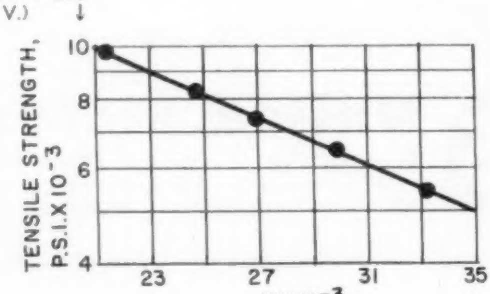


FIG. 4: Points are calculated data, based on Fig. 3. Curves represent observed data. (See Table IV, p. 130.) ←

FIG. 5: Master rupture curve for Delrin. (See Table V.) ↓



needed. Trial and error tests have indicated that the steady-load-time equivalent for the plastics under investigation is approximately 10^{-5} hours. In drawing a master curve based on static tests, this value can be introduced for t in Eq. 7 for all values of T. Once the curve is drawn, however, any combination of values of temperature and time can be used to determine rupture stress or creep. For the master rupture curve the ordinate is the ultimate rupture stress (tensile or flexural) and the abscissa is K.

Creep is calculated by dividing the stress by the tangent modulus at the stress level. The reasoning behind this was described fully recently (3). Briefly, the elongation determined from a breaking strength test at an elevated temperature will also represent an elongation or creep obtained during a creep test at a lower temperature and much longer period of time. A knowledge of the time and temperature will allow calculation of K. The corresponding modulus can then be read from a master modulus curve, for which the ordinate is tangent modulus at the specified stress level and the abscissa is K, and used to calculate the elongation, knowing the stress. This elongation is also equal to the creep at the same stress level as well as the time-temperature period.

Tensile and flexural strengths were determined in accordance with Methods 1011 and 1031, respectively, of Federal Specification L-P-406b, "Plastics, Organic: General Specification, Test Methods." Wet flexural strength was determined by an accelerated boiling test. Specimens were boiled in water for 3 hr. and placed in a bottle containing water at the test temperature. The bottle was capped and placed in the test chamber, which **(To page 194)**

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Significance of oxirane and iodine values in epoxy plasticizers

By Joseph Fath*

The oxirane value (amount of epoxide group) and iodine value (residual unsaturation) of epoxy plasticizers have been widely accepted criteria of their quality when performance tests at secondary use levels in vinyl compounds have not demonstrated distinguishable differences. However, during the course of formation of the epoxy group, side reactions and destruction of the oxirane ring take place, resulting in non-epoxide saturated components in the epoxy plasticizer. Only from a simultaneous consideration of oxirane and iodine values in combination with a knowledge of the identity of the epoxidized structure may the quantity of these by-products be calculated. These non-epoxide constituents have considerable influence over the stability of the epoxy plasticizer *per se*, as well as its long-term performance in the vinyl compound. A low residual iodine value does not necessarily assure the absence of these groups.

The non-epoxide constituents may react further with the oxirane ring to cause its additional destruction. By subjecting the plasticizer to heat, this self-degradation may be accelerated. Degradation is measurable by a decrease in oxirane value and, in the case of the epoxidized soybean oils, by a rapid increase in viscosity. It is, therefore, suggested that loss of oxirane and increase in viscosity on exposure of the plasticizer to a short-term heat test may be used as criteria of the latent destructive factors present in the plasticizer before use.

Because of the inherent reactivity potential of the epoxy plasticizers—their basic distinction from the conventional plasticizers—much comment and caution has been generated by their use. Early adverse experience in terms of exudation on aging and sunlight exposure led to a careful reexamination of the use of epoxy structures in PVC.

Several conclusions were drawn as to the cause of failure of these early products which chemically had been based on epoxidized soybean oil. These conclusions may be summarized as follows: 1) epoxidized soybean oils are not compatible at primary levels; 2) the hydrogen chloride scavenging action of the epoxy plasticizers results in formation of chlorohydrin structures which, in the case of the triglycerides are, *per se*, partially incompatible; and 3) residual unsaturation, relatively high in the early products, caused failure on exposure to sunlight because of inherent reactivity of the residual double bonds with air or with the vinyl compounding constituents. It was further suggested that the use of unsaturated plasticizers in conjunction with epoxies should be avoided due to possible interaction between the two groups. The first of these two problems, which are considered to be inherent in the use of existing epoxies, were overcome by reducing their use to secondary, or even stabilizer levels.

While the first two conclusions were, therefore, derived from the structure of the plasticizer itself, the problem raised by the third could be rectified by a more complete chemical reaction in the manufacture of the plasticizers. Techniques were, therefore, developed to effect a more complete epoxidation—or saturation by oxygen—of the double bonds contained in the specified raw materials. The resulting effects of such epoxidation on the quality and performance of the products are considered in this paper.

Definitions

The majority of the commercial epoxy plasticizers presently marketed is produced by the epoxidation of unsaturated raw materials. Such epoxidation does not necessarily saturate 100% of the double bonds present. Since the presence of double bonds in linear chains is measured by iodine value, the residual iodine value of an epoxy plasticizer reflects the amount of double bond unaffected by the "saturation" process. More specifically, *iodine value* is defined as the number of grams iodine absorbed by the saturation of 100 grams of compound. A low iodine value implies a high degree of saturation.

The oxygen absorbed by the unsaturated raw material during epoxidation can be measured and is expressed as *oxirane oxygen* or *oxirane value*. By knowing the molecular structure of a given raw material and the amount of unsaturation it contains as measured by initial iodine value, it is easily possible to calculate the *theoretical oxirane value* of a fully epoxidized product. Oxirane value measures the amount of epoxidized double bond, whereas

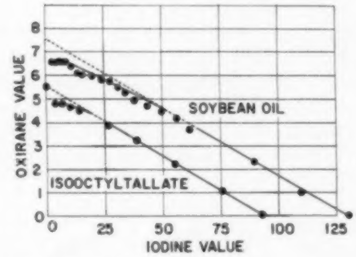


FIG. 1: Epoxidation of soybean oil and isooctyle tallate oxirane and iodine values obtained during course of pilot plant.

*Director of Research, Thompson Chemical Co., Pawtucket, R. I.

Table I: Epoxidation of soybean oil

Sample No.	Iodine value	Extent of saturation	Theoretical oxirane value at point of saturation	Oxirane value found	Efficiency of epoxidation
		%			%
1	130	0	0	0	—
2	110	15.4	1.17	1.00	85.5
3	89.7	31.0	2.35	2.33	99.2
4	61.5	52.7	3.99	3.68	92.2
5	55.8	57.1	4.32	4.15	96.2
6	49.4	62.0	4.69	4.43	94.4
7	43.6	66.5	5.03	4.72	94.0
8	38.1	70.7	5.35	4.95	92.5
9	34.2	73.7	5.58	5.25	94.0
10	31.1	76.1	5.76	5.50	95.5
11	27.6	78.8	5.96	5.71	95.8
12	23.9	81.6	6.18	5.81	94.1
13	20.0	84.6	6.40	5.95	93.0
14	15.9	87.8	6.64	6.00	90.4
15	13.6	89.5	6.77	6.17	91.1
16	11.1	91.5	6.92	6.37	92.0
17	8.8	93.2	7.05	6.56	93.1
18	7.0	94.6	7.16	6.55	91.4
19	5.9	95.5	7.23	6.57	90.7
20	4.7	96.4	7.30	6.49	89.0
21	4.0	96.9	7.33	6.50	88.7
22	3.5	97.3	7.36	6.44	87.5
23	3.1	97.6	7.39	6.54	88.5
24	3.0	97.7	7.40	6.56	88.7
—	0	100	7.57	—	—

Table II: Epoxidation of isooctyl tallate

Sample No.	Iodine value	Extent of saturation	Theoretical oxirane value at point of saturation	Oxirane value found	Efficiency of epoxidation
		%			%
1	92.8	0	0	0	—
2	75.6	18.5	1.02	1.04	100
3	55.0	40.6	2.24	2.20	98.4
4	38.8	58.2	3.21	3.22	100
5	26.8	71.1	3.92	3.87	98.8
6	14.2	84.7	4.66	4.50	96.6
7	10.4	88.8	4.89	4.66	95.4
8	7.2	92.2	5.08	4.79	94.4
9	4.0	95.7	5.27	4.79	91.0
—	0	100	5.51	—	—

Table III: Theoretical oxirane values of an epoxidized soybean oil corresponding to various residual iodine values. (Initial iodine value = 130).

Extent of saturation	Residual I.V.	Theoretical O.V. at 100% efficiency of epoxidation
%		
100	0	7.57
99	1.3	7.49
98	2.6	7.41
97	3.9	7.34
96	5.2	7.26
95	6.5	7.19

iodine value measures the amount of unsaturated double bond. An example of a calculation for theoretical oxirane value follows: 100 g. of a soybean oil having an iodine value of *130* can absorb

$$\frac{16\ (\text{at.wt. of O})}{254\ (\text{m.w. of } I_2)} \times 130 = 8.19 \text{ g. oxygen}$$

The epoxidized soybean oil weighing 100 + 8.19 = 108.19 g. would, therefore, have a theoretical oxirane content of

$$\frac{8.19}{108.19} \times 100 = 7.57\% \text{ oxirane oxygen}$$

The principal current criteria for estimating the quality of an epoxy plasticizer, prior to actual compound evaluation, are examination of the oxirane and iodine values of the commercial product. A high oxirane and low iodine value are considered essential to a high quality epoxy plasticizer.

By examining the chemistry involved in the epoxidized compound, it can be shown that iodine and oxirane values are not necessarily valid as sole criteria of quality. On examination of the oxirane and iodine values of commercial products, it may be seen that the oxirane value is not necessarily equivalent to the amount of iodine value that has been "removed" by the epoxidation process. Thus, referring to the above example of an oil having an initial iodine value of 130, the oxirane value of an epoxidized soybean oil having a residual iodine value of 3 should be

$$\frac{130 - 3}{130} \times 7.57 = 7.40.$$

To date it is difficult to find a commercial product having such a high oxirane value. The "disappearance" of iodine value (I.V.) is then not necessarily attended by a corresponding build-up of oxirane value (O.V.). In order to explain this important discrepancy, the term "extent of saturation" bears introduction: residual iodine value or non-epoxidized double bond of a compound reflects *extent of saturation.*

Extent of saturation (%)

$$= \frac{\text{Original I.V.} - \text{Residual I.V.}}{\text{Original I.V.}} \times 100$$

The process of saturation, how-

ever, does not yield exclusive creation of the epoxy group, but also results in non-epoxide saturates. The actual oxirane value found defines that portion of double bond converted to epoxy structures. The theoretical oxirane value can be determined for any given extent of saturation, as shown in the above example.

It should be noted here that the definition of extent of saturation as given here is not necessarily equal to the percent of total available ethylenic unsaturation converted. While the difference is subtle and minor, it nevertheless exists. The actual oxirane value found, as compared to the oxirane value calculable from the amount of iodine value "removed," therefore, reflects the *efficiency of epoxidation.*

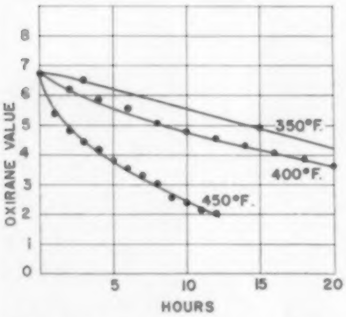


FIG. 2: Effect of temperature on oxirane destruction in an epoxidized soybean oil.

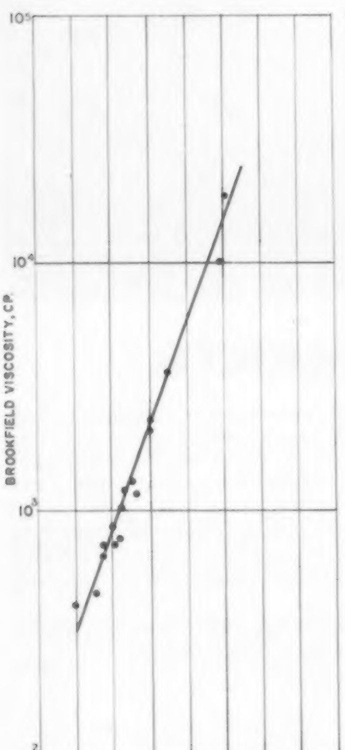


FIG. 3: Effect of oxirane destruction on viscosity of epoxidized soybean oils.

Efficiency of epoxidation (%)

$$= \frac{\text{O.V. found}}{\frac{\%\text{ extent of sat.}}{100} \times \text{Theoretical O.V.}} \times 100$$

Example: An epoxidized soybean oil, prepared from an oil having an iodine value of 130, has a residual iodine value of 3 and an oxirane value of 6.8.

Extent of saturation

$$= \frac{130 - 3}{130} \times 100 = 97.7\%$$

Efficiency of epoxidation

$$= \frac{6.8}{\frac{97.7}{100} \times 7.57} \times 100 = 92.0\%$$

Chemical considerations

In considering the causes and effects of the apparent discrepancy mentioned above, i.e., an extent of saturation and an efficiency of epoxidation both less than 100%, a review of the chemical reactions involved in epoxidation is necessary. Raw materials having internal unsaturation and derived from natural sources contain the following pertinent groups:

I. $-CH=CH-$
II. $-CH=CH-CH_2-CH=CH-$
III. $-CH=CH-CH=CH-$
IV. $-CH_2-CH_2-CH_2-CH_2-$

Groups I, II, and III are epoxidizable according to the reaction:

$$-CH=CH- + O \rightarrow -\underset{\diagdown O \diagup}{CH - CH}-$$

Group IV exists as a saturated compound riding along as an inert material and having a low order of compatibility with PVC. It is usually tolerable in minor amounts and can be removed only by pre-refining at considerable expense or by selecting raw materials having a low initial saturate content.

In evaluating the merits of a high extent of saturation, the following common misconception bears correction: *Residual iodine value does not reflect unreacted raw material;* it measures, rather, the quantity of *partially epoxidized polyunsaturates* in the compound. Of the above groups, III represents a conjugated polyunsaturated group. While one of its double bonds is easily epoxidized, the second is reacted only with considerable difficulty. Residual iodine value, therefore, represents the

$$-CH=CH-\underset{\diagdown O \diagup}{CH - CH}-$$

group, shown to be compatible with PVC in U. S. Patent 2,857,-349. It is much less reactive and more stable than the original raw material. A raw material having a high percentage of conjugated polyunsaturates is, therefore, difficult to reduce to a low residual iodine value.

Because of its inherent reactivity with compounds having labile hydrogen atoms, the oxirane group is capable of reacting further during the process of its very formation. Thus, conditions exist for the simultaneous formation and destruction of the oxirane group. These concurrent reactions account for an oxirane efficiency of less than 100%. When a strong effort is made to remove iodine value through formation of more oxirane groups, the value of such an effort is often reduced or eliminated by an undue rate of destruction of oxirane furthered by such drastic conditions. The oxirane group may react further during the epoxidation process in the following manner:

a) Reaction of the oxirane group with an organic acid present during epoxidation to yield a hydroxyl-acyloxy group:

$$-\underset{\diagdown O \diagup}{CH - CH}- + RCOOH \rightarrow -\underset{OH}{CH}-\underset{OCOR}{CH}-$$

b) Ring opening of the epoxy group by water to yield a dihydroxy group:

$$-\underset{\diagdown O \diagup}{CH - CH}- + HOH \rightarrow -\underset{OH}{CH}-\underset{OH}{CH}-$$

c) Reaction of the oxirane group

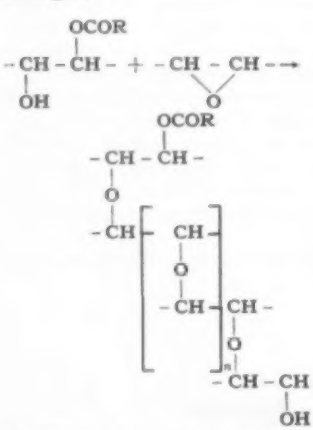
Table IV: Oxirane values of epoxidized soybean oils exposed to 350° F.

Original analytical data					*Oxirane value after exposure at 350° F.*						
Epoxidized soybean oil	*Acid value*	*Residual I.V.*	*Oxirane value*	*Efficiency of epoxidation (assuming 130 starting I.V.)*	*3 hr.*	*15 hr.*	*30 hr.*	*45 hr.*	*60 hr.*	*90 hr.*	*120 hr.*
I	0.14	2.7	6.99	94.3%	6.96	6.89	6.89	6.87	6.86	6.51	6.40
II	0.22	11.3	6.23	88.5%	6.20	6.19	6.12	6.10	6.06	5.90	5.87
III	0.25	5.8	6.55	90.8%	6.54	6.47	6.40	6.36	6.23	5.97	5.90
IV	0.26	3.0	6.37	86.2%	6.27	6.18	5.98	5.70	5.62	4.83	4.38
V	0.20	6.6	6.40	89.0%	6.32	6.27	6.19	6.03	6.02	5.51	5.13
VI	0.13	2.8	6.78	91.5%	6.51	4.90	2.79	Gel	—	—	—
VII	0.53	1.9	6.81	91.2%	6.76	6.69	6.54	6.50	6.40	5.79	5.40
VIII	0.28	1.2	6.94	92.5%	6.78	6.13	5.40	4.92	4.42	2.62	Gel
IX	0.40	5.4	6.25	86.2%	5.53	2.91	Gel	—	—	—	—
X	0.17	1.5	6.95	92.8%	6.95	6.72	6.58	6.40	6.30	5.72	5.15
XI	0.21	1.9	6.94	93.2%	6.93	6.80	6.74	6.73	6.68	6.13	5.77
XII	0.71	1.3	6.73	89.8%	6.65	6.55	6.53	6.50	6.49	6.00	5.73

Table V: Retention of oxirane value by epoxidized soybean oils exposed to 350° F.

		Retention of oxirane value after						
Epoxidized soybean oil	*Efficiency of epoxidation*	*3 hr.*	*15 hr.*	*30 hr.*	*45 hr.*	*60 hr.*	*90 hr.*	*120 hr.*
	%	%	%	%	%	%	%	%
I	94.3	99.5	98.8	98.8	98.3	98.2	93.2	91.6
II	88.5	99.5	99.4	98.4	97.8	97.4	94.8	94.3
III	90.8	99.9	99.0	97.8	97.2	95.2	91.2	90.1
IV	86.2	98.5	97.0	93.9	89.5	88.2	77.4	68.8
V	89.0	98.8	97.9	96.8	94.2	94.1	86.2	80.2
VI	91.5	96.0	72.4	41.2	0	0	0	0
VII	91.2	99.3	98.2	96.0	95.4	94.0	85.0	79.4
VIII	92.5	97.8	88.5	77.9	71.0	63.7	37.8	0
IX	86.2	88.5	46.5	0	0	0	0	0
X	92.8	100	96.8	94.7	92.2	90.7	82.4	74.2
XI	93.2	99.8	98.1	97.2	97.0	96.3	86.5	83.2
XII	89.8	98.9	97.4	97.0	96.5	96.4	89.2	85.2

with the hydroxy-acyloxy group to form a high molecular weight polymer containing "inner" ether linkages:



Reaction c) can also be initiated with the dihydroxy group of b). Further, it is catalyzed by the presence of residual mineral, Lewis, or even strong organic acids, which may not have been removed efficiently from the final epoxy product.

While reactions a) and b) show that only one mole of oxirane group is consumed per mole of acid or water present, in the polymerization reaction c) one mole of hydroxy-acyloxy group may initiate consumption of *n* oxirane groups, the number *n* depending on time, temperature, catalysis, concentration, etc. A relatively small amount of impurity may, therefore, cause destruction of a large quantity of the desirable oxirane groups. As the *rate of destruction* of the oxirane group increases during epoxidation, the efficiency of epoxidation is lowered rapidly.

If the course of epoxidation is followed in terms of efficiency, i.e., if the efficiency is calculated at various stages of the reaction, a point of diminishing returns can be determined. At this point, iodine number can be made to decrease slowly, accompanied however by a definite lack of increase or even by a decrease of oxirane value.

An example of this point can be demonstrated by following the epoxidation of soybean oil (Table I, p. 136) and the epoxidation of isooctyl tallate to isooctyl polyepoxystearate (Table II, p. 136). It will be noted that during the first part of the epoxidation, efficiency is practically 100%, i.e., a given increase in saturation corresponds to a theoretical increase in oxirane value. It is only toward the end of the reaction that efficiency drops off rapidly. Figure

1, p. 135, indicates clearly the point at which further exposure to epoxidation results in low efficiency and a high rate of oxirane destruction.

The reaction products formed by the destruction of the oxirane group are incompatible with PVC. Of these, the polymeric molecule shown in c) and containing "inner" ether linkages is by far the most incompatible structure, in the sense that a plasticized PVC compound can tolerate least of it before exuding. Its incompatibility far exceeds that of any unsaturated components that may be present in the epoxy plasticizer. It should be noted here that a number of polymeric plasticizers used at primary levels in such sensitive applications as vinyl automotive upholstery, have iodine numbers far in excess of any of today's quality epoxy plasticizers and these have caused no undue exudation problems.

In view of these considerations, the user of epoxy plasticizers should look for a product having the highest possible oxirane value accompanied by a reasonably low iodine value, and in addition, a product with a minimum of impurities that will produce inner ether polymeric by-products. Since these impurities are not indicated in specification data, examination of initial analytical values alone does not necessarily assure purchase of an optimum quality plasticizer.

Quality criteria for epoxy plasticizers

Oxirane and iodine values: In examining the oxirane and iodine values of an epoxy plasticizer collectively, the formulator is faced with the task of estimating the value of his data. Admittedly, the higher the oxirane value of a given epoxidized structure, the greater is the amount of double bond that has been converted to the oxirane group. Further, the lower the residual iodine value of the same compound, the greater has been the extent of conversion or extent of saturation. If this saturation could be carried out at 100% efficiency, i.e. with exclusive formation of the oxirane group and in the absence of any by-products, a theoretical maximum oxirane value may be calculated for a given extent of

Table VI: Viscosity of epoxidized soybean oils exposed to 350° F.

Epoxidized soybean oil	*Brookfield viscosity after exposure* 15 hr.	30 hr.	45 hr.	60 hr.	90 hr.
	cp.	cp.	cp.	cp.	cp.
I	428	466	482	504	620
II	370	399	400	390	450
III	448	515	540	568	534
IV	660	859	1018	1210	2140
V	484	548	568	592	726
VI	2288	18750	Gel	—	—
VII	454	528	580	630	900
VIII	736	1320	2212	3656	Almost gelled
IX	10000	Gel	—	—	—
X	490	608	684	736	1142
XI	444	524	520	566	700
XII	494	530	572	610	778

Table VII: Properties of a partially degraded epoxidized soybean oil in PVC at primary levels[a]

					Physical Properties[b]					*Compatibilty*[b] Loop spew, 25° C.			
Plasticizer sample No.	*Time of heating at 450° F.*	*Oxirane value*	*% of original oxirane*	*Calc. eff. of epox. (res. I.V.=2.4)*	*Tensile strength*	*Modulus at 100% elong.*	*Ult. elong.*	*Shore "A" hardness*	*Brittle pt. (ASTM D746)*	*60% R.H.*	*100% R.H.*	*Sun Lamp (ASTM D-795) time to first ex.*	*Heat stability[c] at 350° F.; time to blacken.*
	hr.			%	p.s.i.	p.s.i.	%		°F.			hr.	min.
1	0	6.42	100	86.5	2930	1795	365	91	−17	None	None	860	360
2	1	6.32	98.5	85.0	2825	1745	370	91	−17	None	None	670	360
3	2	6.05	94.2	71.5	2760	1850	335	91	−17	None	V. lt.	455	330
4	3	5.81	90.5	78.3	2750	1865	340	93	−17	None	Lt.	300	330
5	4	5.56	86.7	75.0	2795	1900	350	94	−17	V. lt.	Lt.	192	300
6	6	5.33	83.0	71.8	2725	1910	335	94	−17	V. lt.	Lt.	168	300
7	8	5.15	80.3	69.4	2700	1985	300	95	−9	Lt.	Lt.	48	300
8	10	4.88	76.0	65.7	2655	1985	305	96	−5	Lt.	Mod.	24	300
9	12	4.55	71.0	61.4	2650	1985	275	96	+1	Lt.	Mod.	24	300
10	14	4.44	69.2	59.8	2465	2040	255	97	+3	Lt.	Mod.	24	270
11	16	4.37	68.0	58.8	2405	2015	220	97	+7	Lt.	Mod.	24	270
12	18	4.10	63.8	55.2	2060	1935	140	97	+19	Lt.	Mod.	24	270
13	20	4.01	62.4	53.9	1945	1945	105	97	+25	Lt.	Mod.	24	270
14	48	2.00	31.2	27.0	Does not fuse on milling.								
DOP					2700	1500	320	90	−31	None	None	None	—

[a] To prepare the test specimens, the PVC compounds were milled for 5 min. at 325° F. on a two-roll mill, sheeted off, and molded to 0.075-in. thickness for 3 min. at 345° F. and 1000 p.s.i. pressure.
[b] Formulations for physical property and compatibility tests: TRULON 500, 100 parts; epoxy plasticizer, 50 parts; Ba-Cd. chelate stabilizer, 2 parts; stearic acid, 0.25 part.
[c] Formulation for heat stability test: TRULON 500, 100 parts; epoxy plasticizer, 5 parts; DOP, 45 parts; Ba-Cd. chelate stabilizer, 2 parts; stearic acid, 0.25 part.

Table VIII: Effect of heat on color of epoxidized soybean oils[a]

Table VIII: Effect of heat on color of epoxidized soybean oils[a]

Epoxidized soybean oil	*Residual I. V.*	*Original color*		*Gardner color after exposure at 350° F.*				
		APHA	*Gardner*	*3 hr.*	*15 hr.*	*30 hr.*	*45 hr.*	*90 hr.*
I	2.7	75	<1	3–4	4	4–5	5	7
II	11.3	55	<1	5	6	6–7	8	8–9
III	5.8	115	<1	4–5	5–6	5–6	7	9–10
IV	3.0	95	<1	3–4	4	4	6	9–10
V	6.6	55	<1	4	5–6	7	7	10
VI	2.8	95	<1	2–3	5	8–9	Gel	
VII	1.9	105	<1	4	5–6	7–8	8–9	10
VIII	1.2	90	<1	4–5	6	7–8	9	Gel
IX	5.4	90	<1	6	6–7	Gel	–	–
X	1.5	45	<1	2–3	3	4–5	7	8
XI	1.9	55	<1	2–3	3–4	5	7	9
XII	1.3	75	<1	5	5–6	5–6	7	8–9

[a]Color development of 200 g. samples exposed to 350° F. in loosely covered 250-ml. Erlenmeyer flasks.

saturation. Table III, p. 136, gives such sample calculations for residual iodine versus theoretical oxirane values of an epoxidized soybean oil having a starting iodine value of 130.

The vinyl processor may find that an epoxidized soybean oil having a residual iodine value of about 1, has an oxirane value further removed from the theoretical than one having an iodine value of 3 to 5. Thus, while the *extent of saturation* may be nearer 100%, the *efficiency of epoxidation* may be lower, implying a larger quantity of by-products. Efficiency of epoxidation, then, indicates the manner in which the double bond was converted into the oxirane group, to the extent to which this conversion took place. Since it is derived from simultaneous consideration of oxirane and iodine values, it implies to the vinyl processor the amount of oxirane destruction that exists in the plasticizer.

Oxirane stability as a new criterion for determining quality: As shown above, non-oxirane-containing saturated constituents not only represent an immediate loss of oxirane oxygen content, but also a latent instability factor through further reaction with oxirane groups. Further reaction can easily be measured by an attendant loss of oxirane. If conditions are provided to accelerate this reaction, loss of oxirane may be used as a tool to imply such potential long-term losses.

A number of commercially available epoxidized soybean oils were exposed to a temperature of 350° F. and the change in oxirane content was measured. Specifically, 200 ml. plasticizer samples were placed in 250 ml. Erlenmeyer flasks. These were covered with inverted beakers and placed in an oven. Samples were withdrawn at specified time intervals for analysis. Table IV, p. 140, shows that oils having similar oxirane and iodine analyses respond quite differently to this stability test and are not necessarily equivalent after such heat exposure.

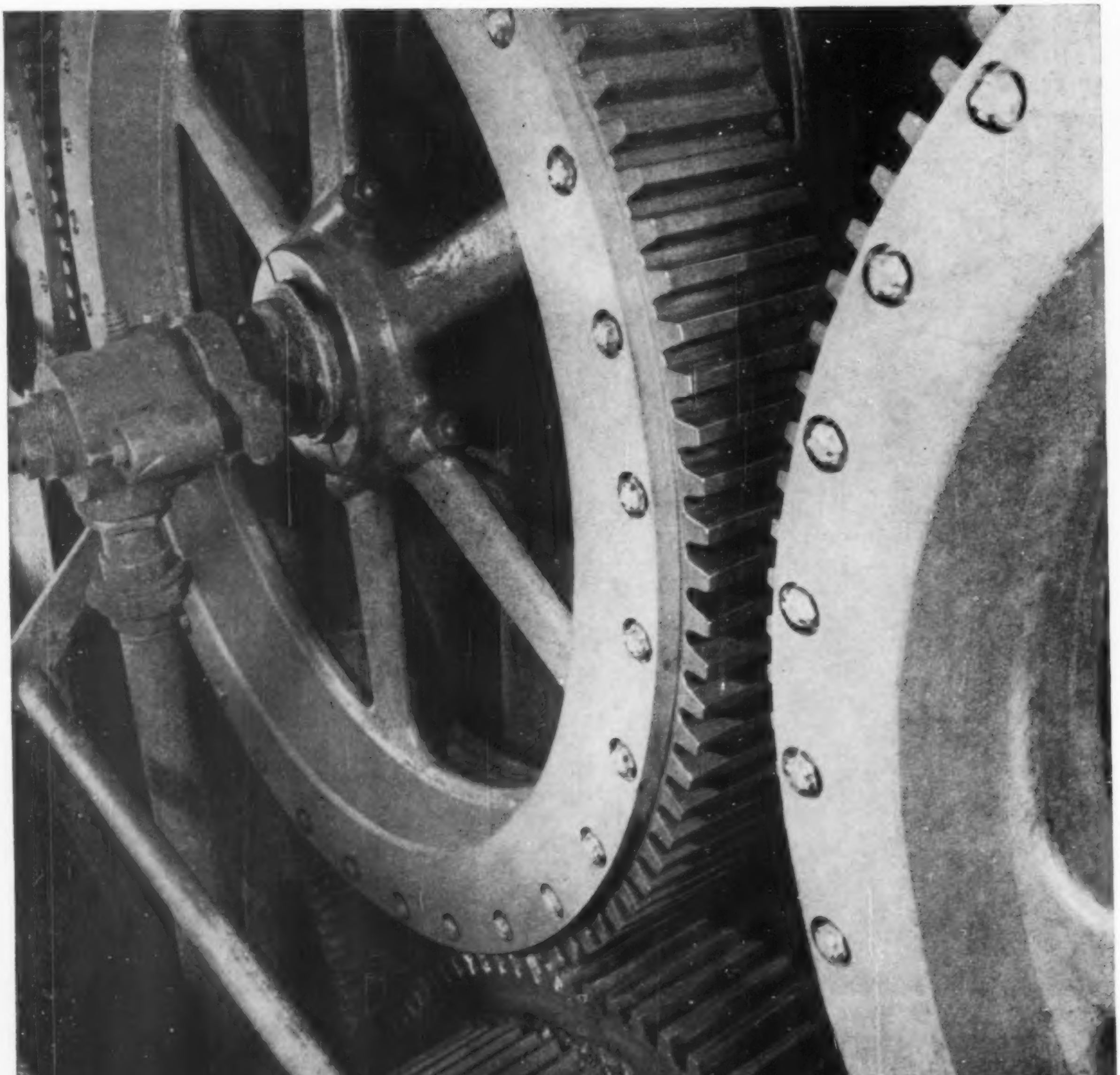
The oxirane values shown in Table IV may also be expressed in terms of *% retention of oxirane value.* This calculation is shown in Table V, p. 140, and is a more direct expression of oxirane stability. This property is considered to be related to the process used in the preparation of the epoxy plasticizer and demonstrates the possible presence of latent oxirane destructive factors as well as those made obvious by low analytical results. It more clearly shows that two plasticizers having a similar initial analysis may have vastly different stabilities.

The rate of oxirane destruction as a function of temperature has also been investigated. Thus, commercial epoxy plasticizer VI, representing a relatively unstable epoxidized soybean oil, has been exposed to 400 and 450° F. in addition to the 350° F. exposure. Figure 2, p. 138, shows that oxirane destruction is faster at higher temperatures and that differences in rates become exaggerated. By choosing appropriate temperatures, a suitable short-term test for oxirane stability may be set up for control purposes.

Viscosity as a measure of oxirane stability: Since destruction of the oxirane group results in internal polymerization, compounds of high viscosity are formed. It has been observed that as this polymerization proceeds to an oxirane value of 0, epoxidized soybean oils will set up to a tough, brittle gel. Viscosity measurements (Table VI, p. 142, and Fig. 3, p. 138), made during the course of the heat tests on the materials reported in Table IV, show a relationship between viscosity and oxirane value, i.e., a viscosity increase as oxirane value decreases. Viscosity of heated samples, whether measured accurately or estimated visually in test tubes, versus that of unheated or unreactive controls is, therefore, suggested as another basis of a rapid plasticizer quality control test.

PVC compatibility and property effects

The effects of partial oxirane destruction in an epoxidized soybean oil by oven heating on its compatibility with PVC and on the properties of the plasticized PVC compound are shown in Table VII, p. 142. It is apparent that only a minor reduction of oxirane value due to polymerization may create highly incompatible constituents. Thus, at an efficiency of epoxidation level of about 80%, the plasticizer degraded in this particular experiment already shows signs of short-term incompatibility under mechanical stress. Primary levels of epoxy plasticizer were used to obtain accelerated evidence of incompatibility. At secondary levels, the total quantity of the polyether polymer formed on degradation is small **(To page 203)**



GEARED TO THE FUTURE—These gears or gear rims used to replace cast iron dryer gears on #5 paper making machine at St. Regis Paper Company's plant at Deferiet, New York, were machined from 6" sheet stock of Panelyte grade 905. The outside diameter of the wheel is 54-7/16". The Panelyte rims have a 6" face with 112 teeth, a 1½" circular pitch on a 53-31/64" pitch diameter. These gears greatly reduce noise and machine vibrations thus improving working conditions and lowering general maintenance costs. Damaged gears are easily replaced by simply substituting a new gear ring instead of replacing the entire hub, arms and rim as was necessary with metal gears. The Panelyte is highly resistant to shock and has excellent machining characteristics. One of the important materials used in the fabrication of these Panelyte phenolic laminates is Mount Vernon Duck.

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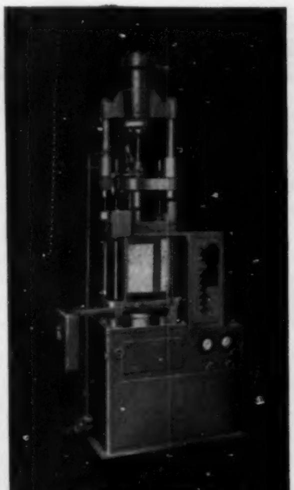

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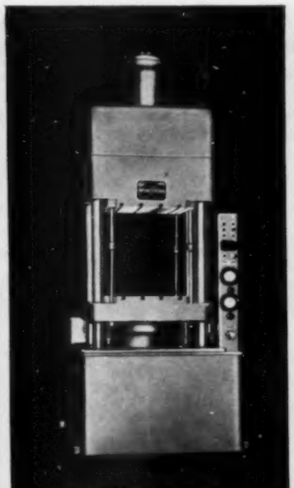

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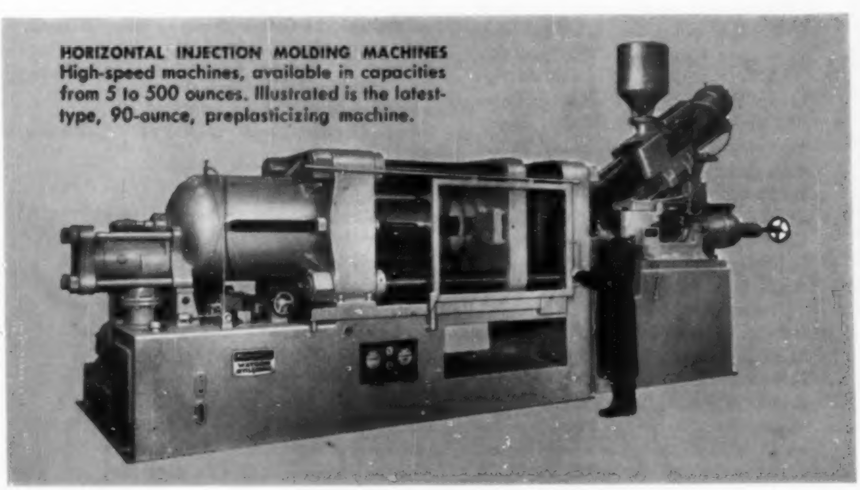

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WS-74

NEW DEVELOPMENTS

Many minds at work on new ways to use plastics, new designs, and new product concepts offer ideas you can use.

Vinyl for trailer walls

Rising maintenance costs have been checked by a Detroit, Mich. trucking firm, through switching from aluminum side panels for its flatbed trailers to custom-made panels of Seilon VHI, a high-impact copolymer vinyl sheeting produced by Seiberling Rubber Co.'s Plastics Div., Newcomerstown, Ohio.

In addition, the use of Seilon instead of aluminum on a test trailer

allowed a payload increase of around 400 lb.; equivalent wooden panels were found to be 700 to 900 lb. heavier. Thus the new material is said to pay for itself through its light weight alone, despite its higher initial cost, which is estimated to be about twice as much as plywood, and nearly three times as much as thin-gage steel or aluminum.

Press-formed into a corrugated, inter-locking design by Sewell Mfg. Co., Madison Heights, Mich., Seilon panels resist denting, breaking, and tearing, and they do not absorb water; thus they will not rust or warp and can be easily washed. Repainting is eliminated. Nontoxic, the panels are said to be suitable for food-hauling runs.

The average life of wooden panels is approximately three years, with considerable maintenance required. The life of thin-gage metal is even shorter. According to Sewell, the new panels "should last indefinitely under normal usage." VHI comes in any color and a variety of gages.

Laminate wall panels

Durability, attractiveness, and insulation properties are combined in a new wall surface paneling of high pressure laminate now being produced by the Micarta Division of the Westinghouse Electric Corp., Hampton, S. C.

The panels, which are made in sections 96 in. high and 0.55 in. thick, are designed for tongue-and-groove jointing on 16 in. centers and can be installed with conventional hand tools by stapling to studs or furring.

The base for the laminate is a treated cellulose core which is said to be resistant to fire, fungi, rot, and termites. This core serves as the panel's visible surface, and requires no painting or waxing. A barrier sheet of kraft paper impregnated with phenolic resin, applied to the back surface, seals the core material, balances and stabilizes the panel over a wide climatic range, and prevents water absorption.

The panels are priced at 72¢ to 80¢/sq. ft. in quantity, and are available in 11 patterns.

Dacron blanket for better prosthetics

The Veterans Administration's Prosthetics Center is now using Troytuf, a mechanically interlocked Dacron fiber blanket, as reinforcement to make its reinforced polyester prosthetic devices structurally stronger, easier to prepare or modify, and better fitting. The new blanket replaces other fillers previously used, particularly nylon stockinette. When modifications were made, the stockinette's ribbed edges would protrude and never could be removed completely. Since the edges were usually in the socket area and in contact with the skin, they would often irritate. No rough edges protrude from the polyester blanket after changes are made.

Use of the blanket is said to improve the process for adding material as well. Previously, this operation was complex and messy, as the filler had to be smeared on the build-up area. Now the area in question is roughed up, a piece of the Dacron blanket is dipped in the laminate resin and applied. The material adheres immediately.

The successful application of Troytuf is attributed by Troy Blanket Mills, producer of the blanket, to the fact that the laminate materials are similar in composition. Troytuf, made of Dacron, a polyester fiber, is combined with a resin, also a polyester.

To make an artificial limb, a simple geometric Dacron form is attached over the socket mold, which is an exact duplicate of the human original. The entire assembly is heated and the Dacron shrinks to the exact size and contour. Though this process is still in the experimental stage, the Center believes that it holds promise for producing improved prosthetic devices.

New approach to drawers

Drawer guide devices, such as rollers, center slides, etc., used for wooden drawers, are eliminated by a new storage system designated strata-panel. The system consists of styrene slide-panels and modular drawers. The ease and speed of installation of the system is said to permit substantial economies—one furniture manufacturer who is using the plastic panels and drawers has reported savings of from 25 to 33 percent.

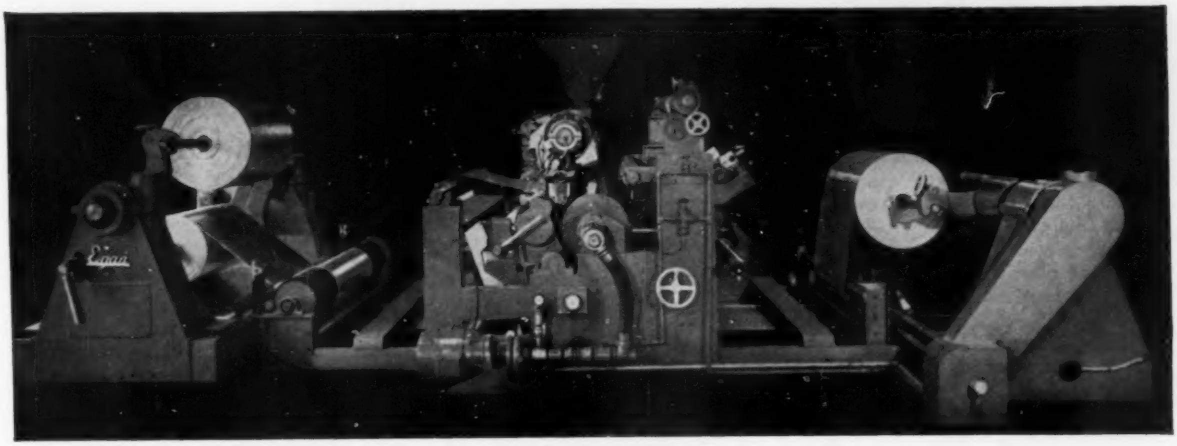
Made by The Moulded Structures Div., Robert A. Schless & Co., Elizabethtown, N. Y., the system is also

MODULAR STYRENE drawers slide along formed-in guides of styrene panels. Top to bottom: 3-in. drawer with formed pull; 6-in. with trimmed edge; and 6-in. with wood front.

available to building contractors, interior decorators, and to the general public for do-it-yourself home improvements. Prices differ with unit size variations and end-use volume, and were not released for publication by the manufacturer.

The styrene panels with formed-in drawer guides are supplied in one standard size, 17⅛ by 24 in., but can be cut by shears into smaller sizes to accommodate **(To page 150)**

why an Egan extrusion coater?



One minute's reading time tells you why!

Above unit installed at Protective Coatings Corporation, Clifton, New Jersey.

Egan is the world's leading manufacturer of extrusion coating equipment. Eighty-five percent of all companies operating extrusion coater-laminators rely on Egan field-tested equipment.

The extruder itself is a proven, dependable, high-capacity, low maintenance unit. Barrel thickness is calculated for optimum heat transfer. Inexpensive high watt-density ceramic resistance heater bands provide fast heat-up, and *improve* your plant's power factor (ceramic heater bands are economical to buy *and* operate).

The center fed, single piece die minimizes dead storage areas and leakage. Rectangular construction lends itself to more even heating without warpage. Standard or extended die jaw designs are available.

Critical parts of the extruder and die are precision manufactured to close tolerances, permitting accurate gauge control and production of thinner films.

A specially designed double-shell internal spiral chill roll, furnished with mirror or matte finish, assures maximum heat transfer rates for cooling the laminate uniformly (less than 2° F differential across roll). It further permits use of smaller diameter cooling rolls which reduces trim losses, the largest single factor in production waste.

Various laminator designs can be furnished, depending upon the substrate to be handled. Open construction of the laminator permits maximum access and visibility by the operator.

Packaged water circulating and trim disposal systems are also provided.

In addition, patented horizontal and vertical adjustments of the laminating nip, which are essential for obtaining maximum adhesion, are included.

A variety of unwinds and winders can be furnished, depending upon individual requirements (from hand-splice operations to automatic flying splice and flying transfer equipment).

In short, Egan gives you the complete machine package, manufacturing both the extruder and the web handling equipment.

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NEW DEVELOPMENTS

(From page 148)

varying drawer heights. All panels are interchangeable, with no left or right designation. A waterproof contact cement, furnished with the system, bonds the panels to such stiff materials as wood, plaster, plywood and masonry. Plywood finished on one side only can be used as a drawer backing material, or existing room or closet wall can often serve as the back side.

The modular drawers, which slide easily along the panel guides, are available in 3- and 6-in. heights, a depth of 17⅛ in., and five widths from 16¹⁄₁₆ to 46¹⁄₁₆ inches. The drawers may be ordered with yellow birch or walnut fronts, with the drawer edge trimmed to receive other fronts, or with an integrally formed pull.

Both slide-panels and drawers are vacuum formed from impact styrene sheet. Material used for this application is Lustrex Hi-test 88 supplied by Monsanto Chemical Co.

PE film covering cuts building cost

Approximately 50¢/sq. ft. can be saved in chicken house construction by the use of polyethylene film instead of wood components for roofing and sides.

In one of the first such applications, a California poultryman used both clear and black PE film in the erection of a 50- by 400-ft. house. His construction costs were about 13¢ to 15¢/sq. ft., compared to 60¢ to 75¢/sq. ft. for a conventional wooden house.

The building was covered by stretching the film over a lath and wire mesh framework. Clear film extends along the sides of the house up to a height of 8 ft., and is also used for covering front and back surfaces. The black PE film continues across the top to form the roof covering. Approximately 9000 sq. ft. of clear and 22,000 sq. ft. of black film were used.

Air enters through roof vents, sunlight through the clear film sides. With good weather conditions, the clear sides can be rolled up to admit maximum air and light. In inclement weather, the sides can be rolled down to minimize colds and drafts.

Film was extruded and supplied by Crown Zellerbach Corp., St. Louis, Mo. Film-grade resin was obtained from Union Carbide Plastics Co., New York, N. Y.

ROOF COVERING of economical chicken house is black PE film over wood and wire mesh framework, vented to permit air circulation. Sides are of clear film to let in sunlight.

High-density PE vases

Extruded sheets of high-density polyethylene, integrally colored in rainbow hues by a color-retaining die adapter, are formed by hand into strikingly original floral vases, planters, and a decorative accessory.

The manufacturer, Diversified Industries Inc., Trenton, S. C., states that because of this hand-shaping process, no two of the plastic items are precisely alike. And although the finished products have been set by immersion in cold water, the user may reshape them to other forms after the plastic has been softened in near-boiling water.

The patented color-retaining die adapter is equipped with several inner offsets, similar to pockets. When small quantities of resins, each of a different color, are fed successively into the extruder, they enter from the extruder orifice into the adapter, where the offsets trap a small bit of the colored extrudate.

FLOWER VASE and planter are produced by hand shaping of an extruded high-density PE sheet. In the center of planter is driftwood-like accessory of same material. Top photo shows the components that went into the flower arrangement above.

Material passing through the adapter picks up fringe colors from the preceding material, and the result is a rainbow color effect. As many as six colors can be imparted to the extruded PE by this process. The fan-shaped die adapter also forms the PE into 12- by ⅛-in. sheet, which is then cut into desired lengths for hand shaping over various metal forms.

Prices for the unbreakable vases and planters, called Flora-Lava, are from $2.30 to $2.95. The Moon-drift accessory, which resembles driftwood, retails for $1.95. High-density PE material is supplied by Koppers Co. Inc., Pittsburgh, Pa.

RP tanks save cost and weight

A 200-gal. glass-reinforced polyester tank, weighing just 55 lb., is approximately one third the cost and weight of a comparable stainless steel tank, and three quarters the cost and weight of aluminum varieties. In addition, it is resistant to many of the chemicals that have an adverse effect on aluminum.

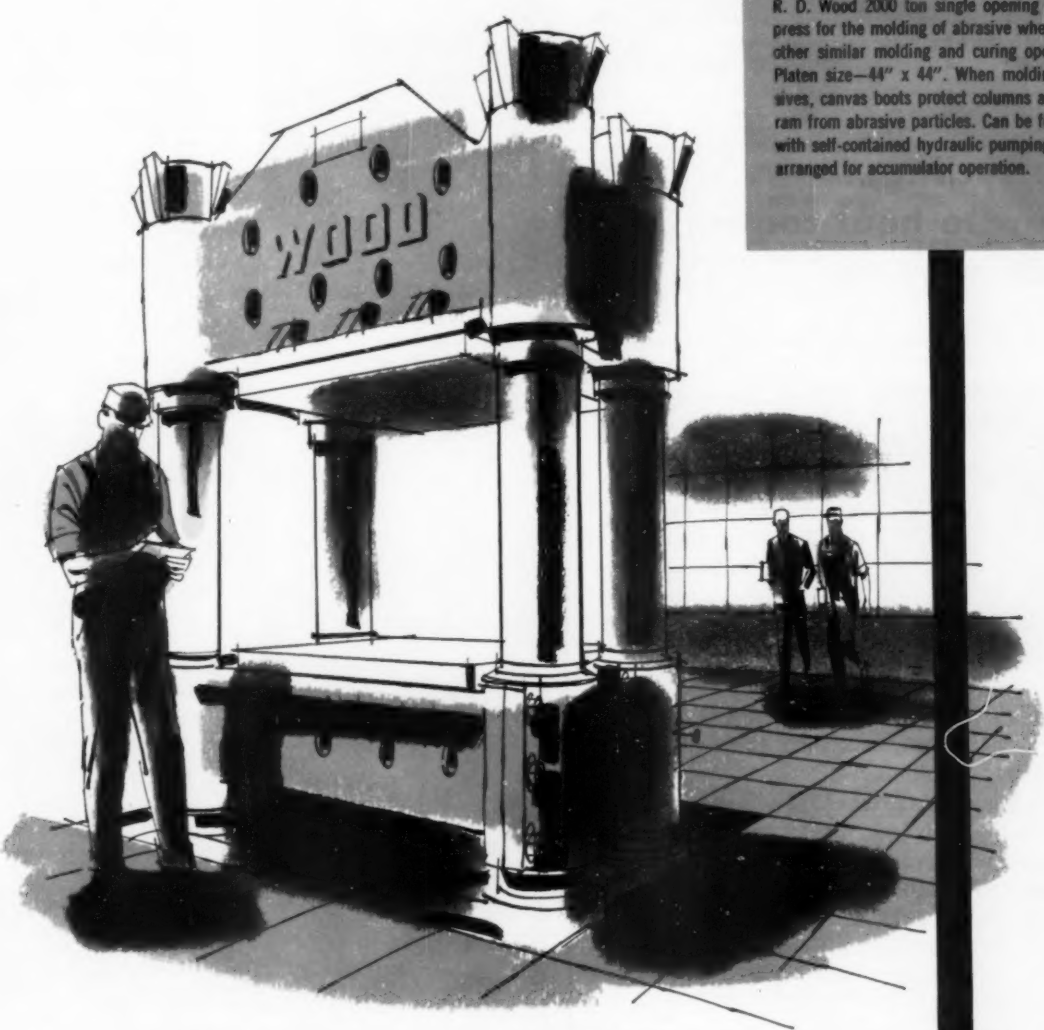
Top wholesale price is about $90 per tank, with additional discounts to volume users and original equipment manufacturers. The tank is 58¾ in. long and 32 in. in diameter, and although it is presently sold only in the 200-gal. capacity, additional sizes and shapes are contemplated by the manufacturer, Molded Fiber Glass Body Co., Ashtabula, Ohio.

Tanks are produced from four parts, matched metal molded of preformed glass mat saturated with polyester resin: two end pieces **(To page 153)**

How to save money on your next press: apply your specs to a basic R. D. Wood design

The result will be exactly *what you want*—just as surely as if you had it designed from scratch. And its cost will be much lower. Working with numerous basic models, R. D. Wood engineers can save considerable design time and expense, and still incorporate *your* specifications in the finished machine. You're sure of its quality, too. For every Wood Press is built by experts using selected materials. This brings additional saving from smooth, dependable performance; fast, economical production; trouble-free operation. *Before* you begin planning your next hydraulic press, consult Wood.

R. D. Wood 2000 ton single opening molding press for the molding of abrasive wheels, and other similar molding and curing operations. Platen size—44" x 44". When molding abrasives, canvas boots protect columns and main ram from abrasive particles. Can be furnished with self-contained hydraulic pumping unit or arranged for accumulator operation.



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and two half-walls. Curing time is several minutes at 150 p.s.i. pressure and 250° F. die temperature. One half-wall is fitted with a gasketed cap for filling and dispensing. Glass mat preform with polyester resin binder is used for tank ends.

After the tank parts are molded, the two ends and two wall-halves

are bonded together with reinforced polyester resin, essentially the same material as the parts, except that ground glass replaces the 2-in. strands of the preform. The bond material is cured by the heat of a catalyst added to the resin.

The RP tank is usually made translucent so loading level can be seen, but it is also available in opaque and translucent colors. The units have been sold for corrosive material storage in the tanning, paper, and chemical industries, and as liquid fertilizer and insecticide sprayer tanks.

Lens and mount in one piece

Produced by double-shot injection molding, a new one-piece plastics lens and mount on bezel has been announced by American Plastics Corp., a subsidiary of Heyden Newport Chemical Corp., New York, N. Y. The unit, developed as a low-cost, durable successor to the conven- **(To page 155)**

ONE-PIECE plastics lens, shown in cross-section, is produced by double-shot injection molding.

tional two-piece glass lens and metal mount, is foreseen for use in clocks and watches, instruments, flashlights—in fact, almost anywhere that transparent dials are used.

Construction of the integral unit eliminates any possibility of the lens loosening or falling out. The lens—polystyrene, acrylic, or any transparent plastic—and the peripheral bezel case, of any thermoplastic material, are molded sequentially in a specially designed double-shot mold. The bezel can be designed for a snap fit or for a screw thread.

. . . And in brief

• Chemically inert crosses lined with Fluoroflex-T are now standard fittings in the process piping line offered by Resistoflex Corp., Roseland, N. J. Fluoroflex-T is a non-porous compound made from tetrafluoroethylene resin. One- to 6-in. type S crosses are currently available.

• Dignified gravemarkers are now molded of Tenite butyrate by WEVon's Plastic Inc., Independence, Mo., for The McComas Co., Kansas City, Mo. Size is 8 by 3½ inches.

• Reinforced polyester tote box, Model 538-1, weighs slightly over 6 lb., or about one-third the weight of conventional metal containers. Outside dimensions are 10¾ by 22 in. (at top) by 8 in. deep. Made by Molded Fiber Glass Tray Co., Linesville, Pa., box is interstackable with 10 by 20 by 8-in. metal containers.

• Extruded reflectorized vinyl strip for traffic marking is available from Auburn Plastics Inc., Auburn, N. Y. Produced in 3-, 4-, and 6-in. widths, 0.040- and 0.070-in. thick, tape comes in 150-ft. rolls.

• Regan Plastics Corp., Glendale, Calif., is molding a line of nylon transistor mounting pads to eliminate difficulties associated with mounting transistors on etched circuit boards.

• Mylar balloon, 100 ft. in diameter, and foldable into a 30-in. package for storage in rockets, is used by National Aeronautics and Space Administration as a signal-reflecting satellite. Gage is ½ mil. Micro-thin coating of aluminum serves as reflecting surface.

• Fisher Scientific Co., Pittsburgh, Pa., now ships reagents in PolyPac, a 5-gal. polyethylene bottle in a sturdy ICC-approved cardboard carton. To use, tubing is attached to pour-spout cap, a clamp to the tubing's free end; and the carton inverted. Thus, reagent can be dispensed as needed, straight from the shelf. PolyPac replaces the heavy and expensive glass carboys that were formerly required.

• Expendable vinyl oxygen masks are supplied by National Cylinder Gas Div. of Chemitron Corp. Masks remain soft and pliable in use, and can be trimmed with shears to conform to unusual facial features.

• Doron, a laminated glass-and-resin cloth material produced by the Westinghouse Electric Corp.'s Micarta Div. and used in bullet-proof vests during the Korean conflict, is now being tried as a protective shielding for U. S. Army ambulances. When a bullet begins to penetrate Doron, the material separates into layers and in so doing, absorbs the kinetic energy of the projectile.

• Washable furnace filters, made of ScottFoam polyurethane foam by AutoFlo Corp., Detroit, Mich., have a double wall of foam and a zipper opening to permit removal of retaining frame.

Filters are made in four standard sizes: 16 by 20 by 1 in., 16 by 25 by 1 in., 20 by 20 by 1 in., 20 by 25 by 1 inch. Prices vary from $4 to $6. The foam is made by Scott Paper Co.

• Batteries that activate Air Force flare targets are now housed in boxes molded of Koppers' expandable polystyrene. Box insulates batteries from high-altitude cold, lets them function efficiently. Manufacturer is Del Mar Engineering Laboratories, Los Angeles, Calif.

• All-plastic food strainers consist of molded high-density PE body and nylon mesh. Polyethylene supplied by British Resin Products Ltd., London, England.

• Disposable protective suit of PVC fiber protects against acids, alkalies, oil, grease, and water; priced at $3.95, suits are marketed by Safety First Supply Co., Pittsburgh, Pa.

• Fabricated from molded Teflon, a new type of bellows, developed by Modern Industrial Plastics, Inc., Dayton, Ohio, is designed for use in valves to eliminate the use of a packing gland around the valve system. The main advantages of this type of bellows are overall economy and flexibility.

• Furniture casters molded of Marlex PE to fit all types of furniture legs have been introduced by United States Caster Cup Corp., Kansas City, Mo. Prices range upward, for a set of four, from 19 cents.—**End**

LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Marine Design Manual for Fiberglass Reinforced Plastics" *by Engineers of Gibbs and Cox Inc.*

Published in 1960 by the McGraw-Hill Book Co. Inc., 330 W. 42nd St., New York 36, N. Y. 376 pages. Price: $15.00.

Without a doubt one of the best books on plastic product design we have reviewed. Definitely recommended for anyone interested in the plastic boat industry and of value to anyone working with fibrous glass reinforced plastic laminates in any field. After a brief introductory chapter on the status of the use of plastic in boats, the book continues with boat hull design, design details, materials and molding methods, engineering properties of laminates, and the design of laminates. Particularly commendable is the rigorous engineering approach used in the solution of engineering and design problems and the generous use of well detailed drawings and sample problems to illustrate the solutions. Loaded with useful data and information, this book is more than worth its cost and should wind up on the best seller list in plastics literature.—*G.R.S.*

"Compression and Transfer Molding of Plastics" *by J. Butler.*

Published in 1959 by Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. 230 pages. Price: $5.75.

Mr. Butler has done a very creditable job of treating this complex subject in depth. Intended for students, designers, and production molders, the book is profusely illustrated with drawings, photos, and pertinent charts. Many practicable suggestions, rather than discussions of vague generalities, make the volume a must for the library of anyone with a serious interest in compression and transfer molding.—*G.R.S.*

"Linear and Stereoregular Addition Polymers: Polymerization with Controlled Propagation" *by N. G. Gaylord and H. F. Mark with Foreword by Giulio Natta.*

Published in 1959 by Interscience Publishers, 250 Fifth Ave., New York 1, N. Y. 571 pages. Price: $17.50.

Volume 2 of the Polymer Review Series, this monumental work summarizes, interprets, and organizes the journal and patent literature on the subject of linear and stereoregular addition polymers which have followed the discoveries of Ziegler and Natta. Fluid and fixed bed catalytic polymerizations of ethylene, propylene, and other olefins are discussed in detail as well as the structure of the polymers thus obtained. A highly technical book, it will be of great value to theoretical and research chemists and chemical engineers interested in the manufacture and properties of low pressure polyolefin polymers. A good background in high polymer chemistry will be helpful to the reader.—*G.R.S.*

Painting vs. Molding In Color. Shows that painting of polystryene and other thermoplastics parts often permits savings when compared with molding in color. 16 pages. *Bee Chemical Co., Logo Div., 12933 S. Stony Island Ave., Chicago 33, Ill.*

Temperature indicating crayons. Describes uses of a line of temperature indicating crayons, coatings, and pellets, which are used in plastic molding and postforming, annealing, etc. Lists 80 temperature ratings, covering range from 113 to 2500° F. in systematically-spaced intervals. Includes Fahrenheit and Centigrade equivalents table. Catalog 5905. 6 pages. *Tempil° Corp., 132 W. 22nd St., New York 11, N. Y.*

Polymer Plant Engineering describes the facilities and personnel available in building complex polymer plants. 16 pages. *Crawford & Russell Inc., 695 Summer St., Stamford, Conn.*

Control devices. Includes product description of motor starters, both manual and magnetic; contactors; relays; solenoids; limit switches; push buttons; static control; and pilot devices; including features, wiring diagrams, dimensions, and a variety of uses. Bulletin GEC-1260D. 72 pages. *General Electric Co., Schenectady 5, N. Y.*

Urethane foams. "Blowing Foams with Isotron" discusses recent developments in foam making techniques; lists some of the uses for urethane foams; compares physical properties of the most widely used insulating and cushioning materials; and includes technical data on Isotron. 4 pages. *Isotron Dept., Pennsalt Chemicals Corp., 3 Penn Center, Philadelphia 2, Pa.*

Production facilities. "Welcome to Synthane" gives pictorial tour of the company's main plant, including production facilities, photos of department heads, etc. 16 pages. *Synthane Corp., Oaks, Pa.*

Flexible vinyl tubes. Dimensions, prices, samples, uses, etc., for Strip-a-Tube, which consists of 10 tubes of flexible vinyl, joined together in a tape-like form for use in low-pressure fluid distribution systems, multi-pressure measurement applications, and as harness in electronic consoles 6 pages. *Jessall Plastics, Kensington 3, Conn.*

Itaconic acid and esters. Properties, handling and storage, toxicology, polymerization, test methods, and other technical data for itaconic acid and its esters, which are used as monomers. 38 pages. *Chas. Pfizer & Co. Inc., 630 Flushing Ave., Brooklyn 6, N. Y.*

Epoxy resin formulations. Instructions for use, general characteristics, working properties, physical and electrical properties, etc., for two epoxy resin formulations: RCM Resin 2/Curing Agent S, 2 pages. RCM Resin 130/Curing Agent D, 2 pages. *Resin Consultants & Manufacturing Co. Inc., 132 Nassau St., New York 38, N. Y.*

Micro hardness tester. Specifications, uses, accessories available, etc., for the Kentron micro hardness testers, which apply dead weight loads from 1 to 1000 grams. Bulletin K-59. 4 pages. *The Torsion Balance Co., Clifton, N. J.*

Metering pumps. Features, arrangements, design and operation, dimensions, capacity-pressure selection data, etc., for a line of heavy-duty metering pumps, which have capacities ranging from 0.65 to 2025 gal./hr.; operates against pressures up to 4000 p.s.i. 12 pages. *Wallace & Tiernan Inc., Belleville 9, N. J.*

Industrial dictionary. Adaptioneering dictionary gives alphabetical list of size reduction, **(To page 158)**

materials handling, mixing, blending, pelleting and densifying activity covering a wide variety of free-flowing dry materials and slurries used in plastics and other industries. 74 pages. *Sprout, Waldron & Co., Inc., 130 Logan St., Muncy, Pa.*

Research labs. Brochure outlines research and development laboratories available to the plastics industries. 14 pages. *DeBell & Richardson Inc., Hazardville, Conn.*

Vinyl latices. Range, physical and general properties, stability, compounding ingredients, fillers and pigments, heat stabilizers, anti-block agents, processing data, etc., for Breon vinyl latices, which are used primarily for the coating and impregnation of fibrous materials. Booklet G3. 12 pages. *British Geon Ltd., Devonshire House, Piccadilly, London W1, England.*

Tote boxes; trays. Specifications, prices, uses, etc., for a line of tote boxes, trays, and other material handling containers. 24 pages. *Regal Plastic Co., 1725 Holmes St., Kansas City 8, Mo.*

Silicones. Product uses, advantages, etc., for using a line of silicone products such as antifoam and release agents, lubricants, electrical insulation, etc. Includes section on silicone rubber compounds. Bulletin CDS-219B. 8 pages. *Silicone Products Dept., General Electric Co., Waterford, N. Y.*

Plastics for Industry. Catalog gives prices and complete information on grades, sizes, and tolerances of warehouse stocks of plastic sheet, rod, and tubing and other forms. 56 pages. *Almac Plastics Inc., 600 Broadway, New York 12, N. Y.*

Vinyl acetate. Properties, uses, etc., for a line of Darex vinyl acetate homopolymer and copolymer emulsions. Brochure also serves as jacket for filing technical data sheets. 4 pages. *Dewey & Almy Chemical Division of W. R. Grace & Co., Cambridge, Mass.*

RP sheet stocks. Price schedules, thicknesses and tolerances available, etc., for a line of fibrous glass reinforced polyester, electrical grade thin sheet and custom heavy sheet stocks. 3 pages. *Glastic Corp., 4321 Glenridge Rd., Cleveland 21, Ohio.*

Air compressors. Specifications, dimensions, accessories, uses, etc., for a line of stationary air compressors used in plastics **(To page 161)**

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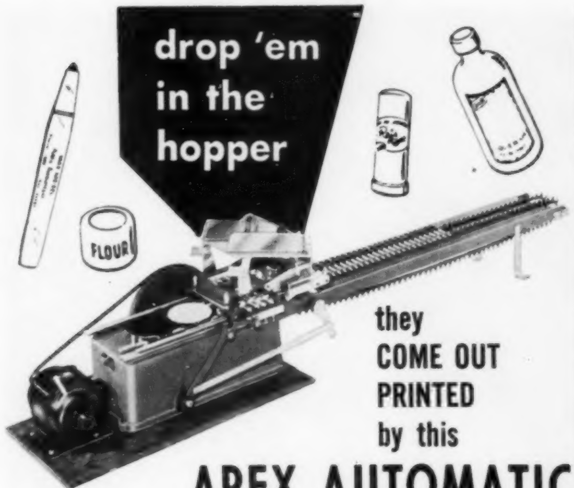

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industries and others. Bulletin A-72. 24 pages. *Joy Mfg. Co., Henry W. Oliver Bldg., Pittsburgh 22, Pa.*

Thermocouples. "ISA Tentative Recommended Practices on Thermocouples and Thermocouple Extension Wires" includes sections on color coding, terminology, fabrication, checking procedures, installation, applications and temperature-EMF tables. Bulletin ISA-RP1.1-7. 32 pages. Price: ISA members, $2.00; others, $3.00. *Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.*

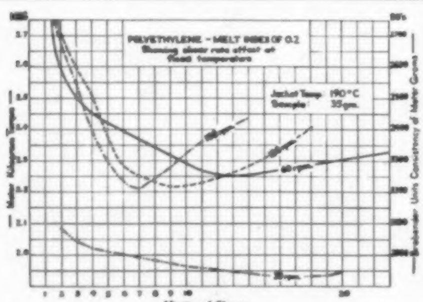
Infra-red ovens and components. Eleven case histories show how an infra-red system can be used for heating, baking, drying, dehydrating, and curing plastics. 8 pages. *Fostoria Corp., Infra-red Div., Fostoria, Ohio.*

Wood particle binder resins. Description, comparison of properties, formulation, molding operation, material and equipment suppliers, applications, etc., for Melurac 304 melamine-urea and Cymel 405 melamine resins in wood-flour molding. Bulletin 1. 14 pages. Bulletin 2. 12 pages. *American Cyanamid Co., Plastics & Resins Div., 30 Rockefeller Plaza, New York 20, N. Y.*

Industrial rolls. Production facilities, design features, uses, etc., for a line of flexographic plate, micro-precision, ink transfer and applicator, embossing, and other industrial rolls for plastics, packaging, printing, etc. 16 pages. *Paper Machinery & Research Inc., Oak St., Roselle, N. J.*

Expanding agents. Physical properties, solubility, storage stability, handling precautions, compounding techniques, formulation, milling, and extrusion data, etc., for using Celogen-AZ, a nitrogen blowing agent, for expanding polyethylene, polypropylene, and calendered and plastisol vinyl foams. Bulletin C-101. 7 pages. Similar data for Celogen, a nitrogen blowing agent, used for expanded polyethylene and polyvinyl chloride. Bulletin C-102. 4 pages. *Naugatuck Chemical, Div. of U. S. Rubber Co., Naugatuck, Conn.*

Polycarbonate resin. Mechanical, thermal, electrical, moisture and weathering, and chemical resistance properties; fabrication data, processing techniques, and applications for Merlon, a new polycarbonate resin that is a linear aromatic polyester of carbonic acid. 22 pages. Similar data in chart form. Bulletin TIB 41-M1. 6 pages. *Mobay Chemical Co., Pittsburgh 34, Pa.*—**End**



Plastics Digest

(From pp. 56, 58)

cles fabricated from TFE-fluorocarbon resins are largely determined by the crystallinity developed during fabrication. As with other semicrystalline plastics, the density of the article increases with increasing crystallinity. The unusual nature of TFE fabrication processes leads sometimes to the formation of small voids which affect the properties of the final article including the apparent density. In order to control crystallinity and void content during fabrication, a method is required to measure the inherent density, that is, the density of the material in the absence of voids. The inherent density is a direct measure of crystallinity. Comparison of the inherent density with the apparent density allows calculation of the void content. It has been found that the torsion modulus of specimens made from TFE resins is determined by the crystallinity and is independent of the void content.

Use of thermoset laminated plastics in electronic applications. P.V. Brown. SPE J. *15*, 974-77 (Nov. 1959). A test method is described for use in the measurement of linear thermal dimensional changes in laminated plastics, used primarily as circuit board. The instrument, a quartz-tube dilatometer, and the testing procedures are discussed.

Publishers' addresses

A.S.T.M. Bulletin: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

British Plastics: Iliffe & Sons Ltd., Dorset House, Stamford St., London SE1, England.

Corrosion Technology: Stratford House, 9 Eden St., London NW1, England.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., Northwest, Washington 6, D. C.

Journal of Applied Chemistry: Society of Chemical Industry, 56 Victoria St., London SW1, England.

Journal of Applied Polymer Science: Interscience Publishers Inc., 250 Fifth Ave., New York 1, N. Y.

Journal of Polymer Science: Interscience Publishers Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonard-Eck Strasse 7, Munich 27, Germany.

Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Plastics (London): Temple Press Ltd., Bowling Greene Lane, London EC1, England.

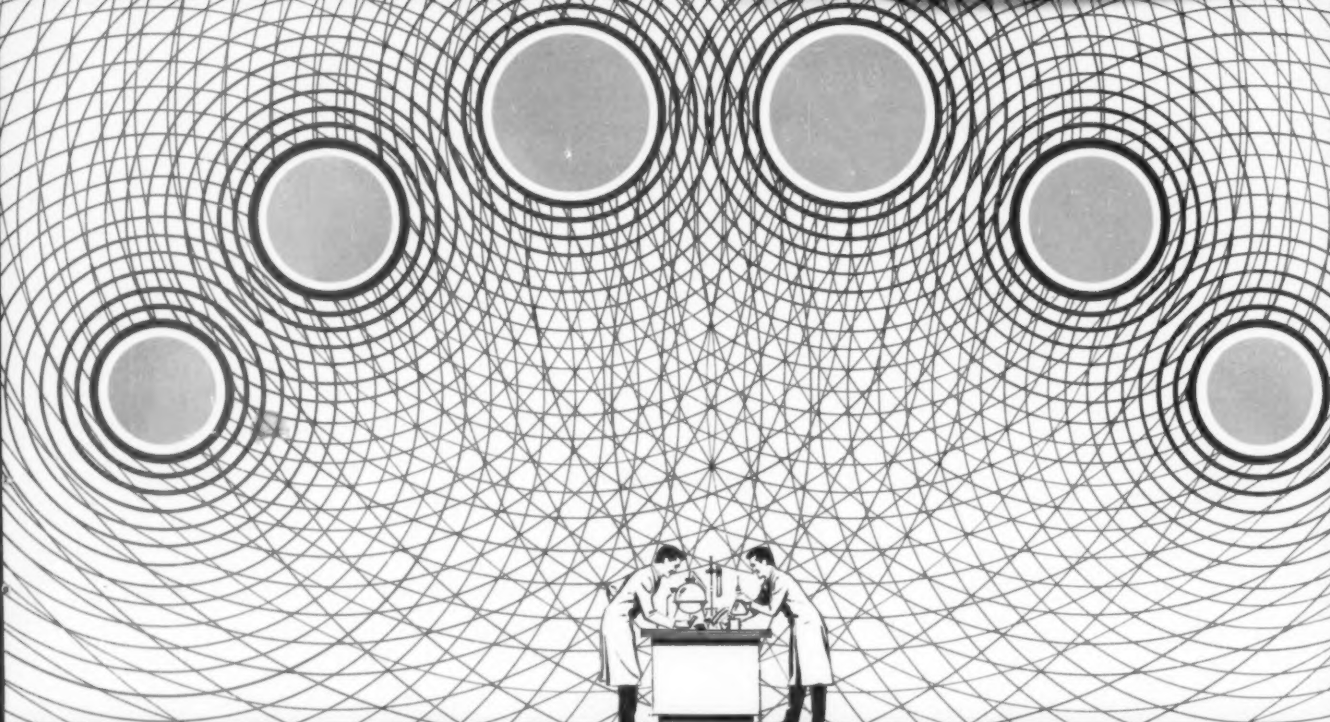
Plastics Institute Transactions & Journal: The Plastics Institute, 6 Mandeville Pl., London W1, England.

Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

Rubber and Plastics Age: Rubber and Technical Press Limited, Gaywood House, Great Peter St., London SW1, England.

SPE Journal: Society of Plastics Engineers Inc., 65 Prospect St., Stamford, Conn.

Vysokomolekuliarnye Soedinenia: Academy of Science of U.S.S.R., Moscow, Russia.—**End**



Plastics Patents

(From page 60)

Gary Jr., and C. T. Patrick Jr. (to Union Carbide). 2,918,439 and 2,918,444.

Copolymers. A. D. F. Toy and K. H. Rattenbury (to Victor Chemical). 2,918,449.

Haloethylene polymers. R. L. Hudson (to Dow). 2,918,450.

Halogenated hydrocarbon resins. S. B. Elliott (to Ferro). 2,918,451.

Melamine resins. K. A. Kun and J. A. Schmidlein (to American Cyanamid). 2,918,452.

Ion exchange resin. G. Widmer (to Ciba). 2,918,453.

Condensation polymers. B. Graham (to Ethyl). 2,918,454.

Polyamides. E. Elrod, R. E. Dorr, H. Braun, J. Elian, and M. Lepingle (to Cellulose Chemie and Cellulose-Polymers). 2,918,455.

Halogenated butyl-dihydrocarbotin sulfide polymers. L. S. Minckler Jr., D. L. Cottle, and T. Lemiszka (to Esso). 2,918,456.

Propylene-butene coplymer. J. L. Jezl (to Sun). 2,918,457.

Olefin polymers. G. Nowlin and H. D. Lyons (to Phillips). 2,918,458-9.

U.S. Pats., Dec. 29, 1959

Halogenated polyolefins. P. J. Canterino (to Phillips). 2,919,252.

Alkyd resins. W. F. Hart (to American Cyanamid). 2,919,253.

Acrylamide interpolymers. R. M. Christenson and H. A. Vogel (to Pittsburgh Plate Glass). 2,919,254.

Epoxy interpolymers. D. P. Hart (to Pittsburgh Plate Glass). 2,919,255.

Polyvinyl chloride. R. A. Naylor and W. B. Hardy. 2,919,259.

Keto acid-carbonyl interpolymers. R. M. Christenson and L. O. Cummings (to Pittsburgh Plate Glass). 2,919,261.

Polysulfide liquid polymers. W. R. Nummy (to Dow). 2,919,262.

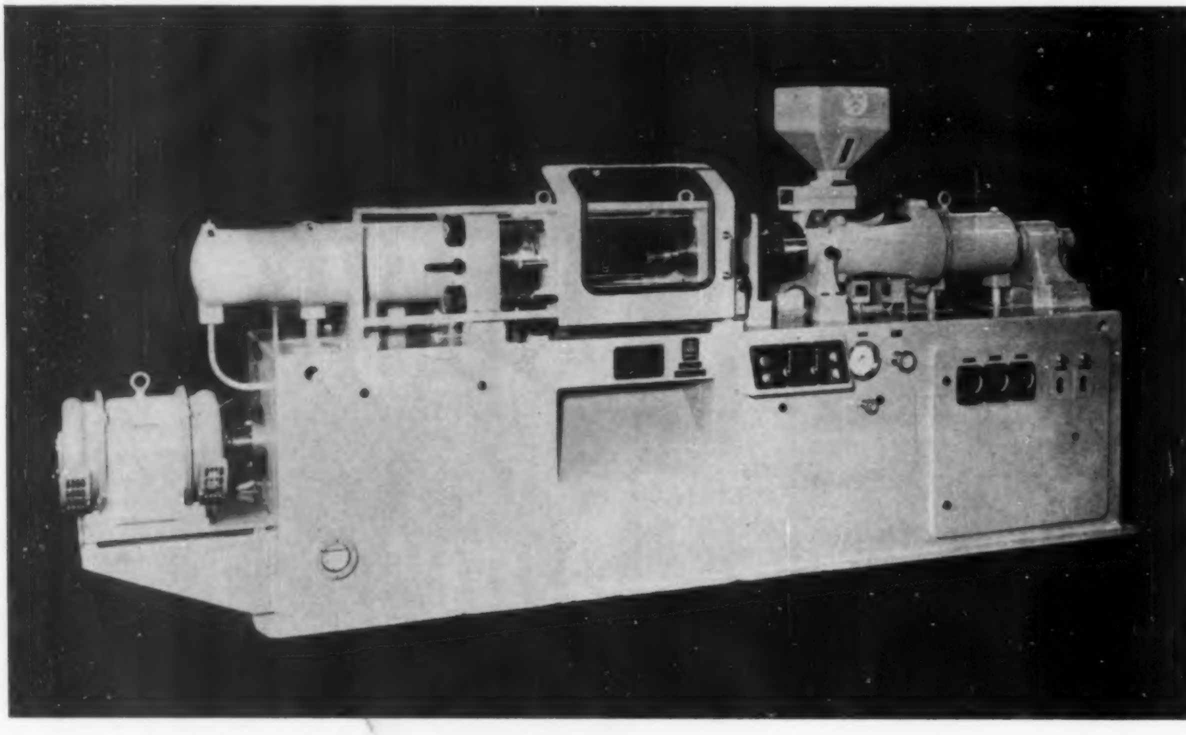
Fluorine-containing polymers. K. H. Kars, H. H. Frey, O. Scherer, and H. Hahn (to Lucius & Bruning). 2,919,263.

U.S. Pats., Jan. 5, 1960

Footwear. S. G. Shuttleworth (to Leather Industries). 2,919,453.

Rolling plastic strips. I. Spinner. 2,919,468.

Injection molding. R. T. Wheeler (to Crown Cork). 2,919,469.—End



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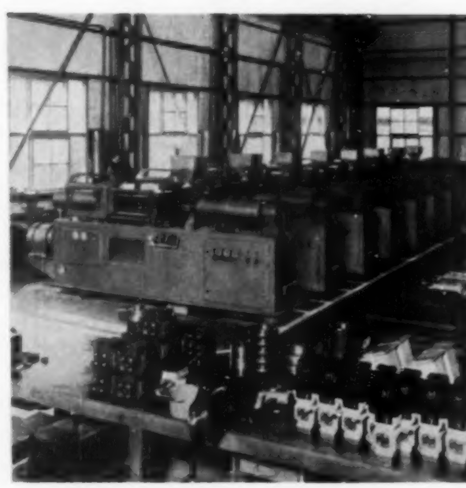

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Colorants

(From pp. 81-85)

The choice of colorant for a paste dispersion for polyesters can be complicated by the peroxides used. For example, phthalocyanine colors are very good when used with methyl ethyl ketone peroxide, but tend to bleach out in the presence of benzoyl peroxide. On the other hand, the cadmium yellows work very well with benzoyl peroxide, but tend to bleach out upon outdoor exposure in the presence of methyl ethyl ketone peroxide.

Picking the coloring technique

As important to the processor as the type of colorant being selected is the form in which to buy it. This question too has its own set of conditions which will determine final choices. Deciding whether to use colored resin, masterbatch colors, paste colors, or dry colors is determined by:

1. The degree of color dispersion that is required in a specific finished product.
2. Plant cleanliness.
3. The ease of handling one form of color versus another in the course of production.
4. The type of production equipment to be used.
5. The amount of pigment needed in the finished product to obtain the proper shade.

Basically, dry coloring works very well with polystyrene and low-density polyethylene and there has been some success with the technique on vinyl. More recently, the development of mechanical mixing inserts mounted in the nozzles or cylinders of injection molding machines has helped add high-density polyethylene and polypropylene to the list.

If the molder does his own dry coloring simply with a tumbling drum, the dispersion he obtains is generally not as thorough as with the other forms of mixing (except in the case of those very large processors or basic resin manufacturers who have the necessary equipment to do more work on the resin-colorant mix). However, it is usually good enough (particularly in thick-wall moldings or extruded parts)

to do the job. In recent years, considerable work has been done on improving dispersion.

Among other limitations is the possibility of color dust (since dry color is in powder form) contaminating other jobs. If steel drums are used for mixing, they need careful cleaning between color changes; but disposable fiber drums can solve this problem.

Masterbatch colors, since they are granular, are cleaner and easier to handle—but are more expensive to work with (see section on "The Cost of Color," below). Much work has been done in this area in designing masterbatches that are geared to particular applications.

The amount of pigment needed to produce a given shade can also influence the decision whether to use dry colors or masterbatch. For example, if the formula calls for only 1 oz. of pigment, the difficulty of weighing such a small amount accurately may encourage the compounder to choose a 10 to 20% masterbatch or paste of the pigment, thereby increasing the amount of material to be weighed, and thus the accuracy of the blending.

The very nature of polyesters or epoxies generally demand the use of paste concentrates that can be incorporated into the resin by a simple stirring operation prior to molding. Most of these concentrates are of an inorganic nature; the only organics that work out well are the phthalocyanines, hansa yellows, BON reds, and a variety of specialized vat pigments.

Pastes are also used in coloring vinyls—the fluid pastes in vinyl plastisols, and the stiffer pastes where 2-roll mills or Banburys are involved.

The cost of color

Riding herd on all these factors, of course, is the over-all consideration of costs.

Colorant costs: The individual price per pound of the various colorants that can be used range all over the lot—from pennies a pound for some of the carbon blacks to as much as $25/lb. for some of the specialized pigments with outstanding heat and light stability. The amount of pigment that has to go into the resin will, of course, also influence the final costs. To achieve flesh color in vinyl, for example, as little as 1/100% colorant is required; to achieve opacity in a vinyl credit card, on the other hand, the loading can go up to as much as 20% or more. The brightness or coloring power of the colorant is also an influence, since in some shades, you can use less organic pigments than inorganics to achieve a desired color.

One supplier interviewed in the course of this survey set the average cost of colorants today at about $1.25/pound. The same supplier had set the average cost of colorants within the past five years at $2/pound. While these are only overall averages, they do show that costs, probably on the basis of volume and improved production techniques, are going down a little.

Processing costs: One supplier has estimated that dry coloring polystyrene costs about 1¢/lb., while the cost of colored resin is somewhere in the 1½¢ to 2¢/lb. category. Another supplier has set the following average on working with high-density polyethylene: using masterbatch techniques to color a resin reduces cost by about 2¢ over the cost of buying colored resin from a supplier (about 6¢/lb.); dry coloring cuts the cost by about 4 cents. Two actual case histories on pigmenting high-density polyethylene established the following differentials:

	Green ¢/lb.	*Yellow* ¢/lb.
Cost of using dry blend color over cost of resin	0.010	0.013
Cost of using masterbatch color over cost of resin	0.017	0.021
Cost of using colored resin over cost of resin	0.060	0.060

There are certain intangibles which also must be taken into account, for example, the question of inventory. Buying the colored resin direct from the supplier may leave you with an expensive stock of committed colors that cannot be changed. With dry coloring or masterbatch, on the

other hand, inventory problems are simplified, since the user need only stock crystal resin and a few colors to meet his requirements. (It is interesting to note that several raw materials suppliers are meeting the cost problem in some new and unusual ways. Several suppliers today, for example, offer plans based on pooling of orders to permit production on the scale that allows a reduction from a premium of 3½¢ or 4¢ over uncolored polystyrene to 1½¢ or 2¢ a pound.)

Equipment costs are also involved. Many of the self-coloring techniques require added mixing equipment and additional time spent in working to achieve a desired dispersion. In cases where small volume production runs are the order or frequent color changes on the same equipment are necessary, it may sometimes be less expensive to buy colored resin than invest in equipment. Where large volumes and a relatively small number of colors are involved, the reverse is usually the case.

The final choice

It must again be emphasized that the foregoing are only the basic ground rules to be followed. The business of colors and coloring is an extremely complex one, requiring the ideas and services of many specialists.

In setting up a check list for color selection, however, these ground rules are of some value. As a case in point, let us assume a manufacturer has decided to produce a green polypropylene monofilament for outdoor use.

Since color used in monofilaments requires excellent dispersion, a Banbury masterbatch is indicated for this end use and since polypropylene is processed at temperatures up to 500°, an inorganic green or phthalocyanine green is required to meet this temperature condition. Since outdoor use is indicated, only those colors having acceptable light stability can be used—again either inorganic green or phthalocyanine green. Cost of color is always an important factor. Therefore, phthalocyanine green is selected because of very high tinting strength or coloring power per

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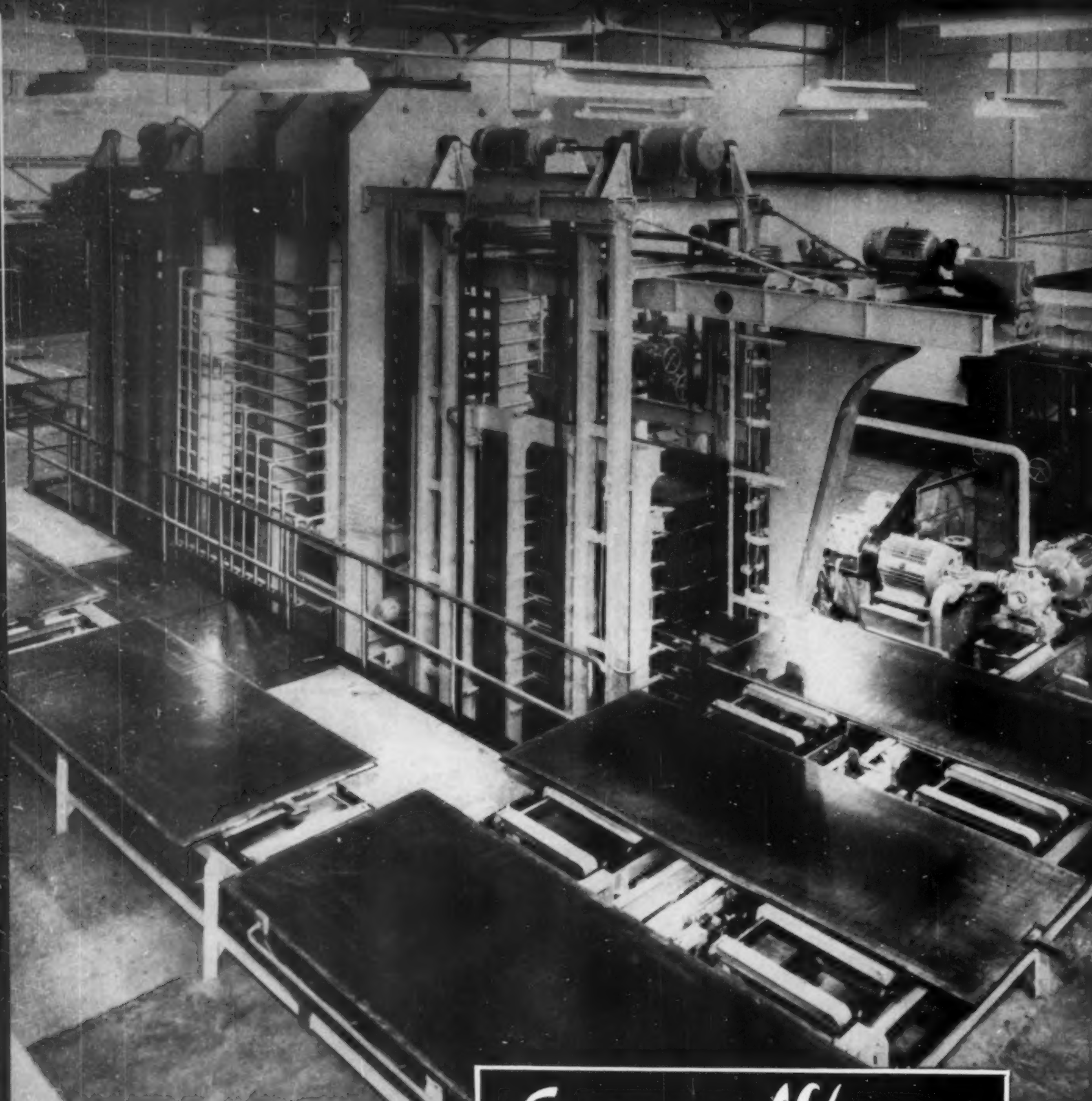
pound cost. A color masterbatch in the ratio of 1 part color to 10 parts of resin is indicated. A higher masterbatch ratio would be more costly while a lower one would result in poor distribution. In the latter case, poor distribution would result in excessive filament breakage.

By using the ground rules to set up a simple line of reasoning of this type, the processor can make the initial step in color selection. Later articles in this series will cover the finer points of colors and colorants, as well as coloring techniques.

The complete list of color and colorant suppliers who made material available for this article is listed in the table on page 1098 of the *Modern Plastics Encyclopedia Issue for 1960.*

For special assistance in the preparation of this phase of the color series, thanks go to: J. Simpson and D. Brush, Ferro Corp., Color Div., Cleveland, Ohio; M. W. Fletterich, The Harshaw Chemical Co., Cleveland, Ohio; D. F. Behney, W. E. Hansen, and C. J. Harwick, Harwick Standard Chemical Co., Akron, Ohio; L. R. Sherman, Imperial Color Chemical & Paper Corp., Pigment Color Div., Glens Falls, N. Y.; V. C. Vesce and M. Saltzman, Harmon Colors, National Aniline Div., Hawthorne, N. J.; R. E. Brouillard, L. Katz and E. A. Wich, General Aniline & Film Corp., Pigment Dept., General Dyestuff Co., N. Y., N. Y.; R. S. Blake, Plastics Color Co., Chatham, N. J.; W. B. Bradbury, Plastic Molders Supply Co. Inc., Fanwood, N. J.; R. Steinman, Garan Chemical Corp., Gardena, Calif.; M. Neitlich and Hal-Curtis Felsher, Claremont Pigment Dispersion Corp., Roslyn Heights, N. Y.; E. Jones, Standard Ultramarine & Color Co., Huntington, W. Va.; W. Oliphant, Patent Chemicals Inc., Paterson, N. J.; J. Pisetzner, Ansbacher-Siegle Corp., Staten Island, N. Y.; D. L. Wardell, Sandoz Inc., New York, N. Y.; G. Kerstein, The Blane Corp., Canton, Mass.

Thanks also to The Dow Chemical Co., E. I. du Pont de Nemours & Co. Inc., and Koppers Co. Inc. for their help in the preparation of this article.—**End**



Hot-stamped tags

(From pp. 90-91)

heads are required, and it has often been found that only two heads are needed to impart the necessary license information to the tags. The first die head is a rotary stamper which sequentially applies the license numerals in the proper color. It prints only those license numbers which are actually held by registered car owners, thereby eliminating unnecessary sorting out of wasted tags, and making possible earlier mailing dates. Other heads are standard ram-pressure types for stamping such information as year, state name, and state motto.

After the stamping operation, the tags are carried by the rotary table to the ejection magazine. Here again, a cam action operates to feed the tags into the magazine. When the magazine contains approximately 100 tags, the operator fits the spindle through the end holes of the key tags, applies the spring clip, and removes the miniature license plates.

Significance of plastic tags

At the present time, key tags of eight states are being produced in cellulose acetate: Alabama, Alaska, California, Illinois, Maine, New Hampshire, Virginia, and West Virginia. The tags of at least five other states—Louisiana, New York, Vermont, and parts of Ohio and Texas—will appear this year. DAV officials express hope that by the end of 1961, all of the key tags will be of the plastic type.

This application of plastics, with its resultant saving of production cost, represents one method by which non-profit organizations can realize financial soundness in their service programs. When such organizations make a finished product for solicitation of contributions, yet set no definite price on the item, they must rely on careful production economics to make the project worthwhile. The expected savings with the cellulose acetate key tags, a good example of sound production planning, will certainly aid the DAV in its service and rehabilitation program for disabled veterans.—**End**

Styrene foam

(From pp. 100-101)

3. The insulation of large containers which hold large numbers of smaller containers for packaging applications.

4. Dispatch of samples as air freight. These are usually small articles which have to be sent great distances.

5. Dispatch of goods affected by heat and moisture characteristics to tropical countries.

6. Protective packaging for articles that are adversely affected by low temperatures.

7. Protective packaging for articles which have to be stored for a long time, such as machine parts which have to be protected against corrosion.

8. As packing pieces for protection against shock and as a thermal insulation.

Marine uses

As the foams are completely buoyant they are used with advantage as fishing floats, buoys, life rafts, life jacket fillings, and life belts. An interesting and successful development is the production of water skis with a polyester coating. With these skis it is possible to walk on the surface of the water.

In the construction of boat building, inlays of foam produce unsinkable life boats, speed boats, cruising boats, and similar boats. The foams are also used for thermal and acoustic insulation.

Advertising and display

In display, striking and relatively cheap moldings of complicated shapes have found wide use. Articles produced include stands for exhibitions, display figures, signs, Christmas bells, and wall tiles. Decorative articles are also cut out of sheets by means of a hot wire cutter.

Other applications

Polystyrene foams have also proved suitable for other applications: Beehives, shoe inserts, bobbins for calculating machines, flower pots, moldings for covering acid baths, inserts in the heels of ladies' shoes, the inner parts of airplane rudders, sails for wind machines, and others.

In general, polystyrene foams have shown themselves also suitable for many applications where metal, wood, ceramics, papier-mâché, cardboard and similar natural materials have previously been used.

References

1. F. Stastny, "Kunststoffe" 173-186, 223-226. (1954); "Der Plastverarbeiter" 260-271 (1954).

2. F. Stastny, "Kaeltetechnik" 75-78 (1955); F. Stastny and K. Koehling "Der Plastverarbeiter" 249-256 (1959).

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4. H. Osken, "Der Plastverarbeiter" 122-130 (1957); F. Stastny, "Das Baugewerbe" 648-654 (1957).

5. F. Stastny, "Die Neue Verpackung" 315-317 (1957); F. Graf, "Verpackungsrundschau" 588-594 (1959).—**End**

• • •

American foam developments will be covered in a forthcoming issue.

Vacuum hopper

(From pp. 105–108)

the same conditions, the blend exposed to air did not become free of porosity until 15 min. after the application of the vacuum. The blend stored in the sealed polyethylene bag required 7 min., the same time as a freshly prepared blend. Thus in this formulation, entrapped air can be considered to be the primary cause of porosity while moisture can be a secondary cause, depending on storage conditions.

In some clear plasticized compounds, the use of vacuum has produced extruded products having less color. This is no doubt due to the exclusion of air and consequent reduction in oxidative degradation. As a good example, non-toxic tubing using little or no stabilizer has been successfully extruded from dry blend.

Type II rigid PVC

The vacuum extrusion of Type II, high impact rigid PVC, from a "dry blend" or powder mix has shown encouraging results. The modifiers used in Type II rigid PVC are considerably more hygroscopic than typical plasticized PVC blends. Plasticized PVC dry blends show approximately 0.10% moisture compared with 1.5% for a widely used modifier as determined by analyses by the Karl Fischer method. This additional moisture aggravates the porosity problem in dry blend extrusion of Type II PVC products.

With the vacuum hopper Type II PVC products completely free of porosity have been obtained. Figures 5 and 6, p. 108, show examples of extruded products obtained with and without the vacuum. A typical formulation used in these studies is (numbers represent parts by weight):

Escambia PVC-2200[3]	100
Acryloid KM 227	15
Acryloid K 120	5
Liquid tin mercaptide	3.0
Calcium stearate	1.0
Titanium dioxide paste ($70\%\ TiO_2$)	1.4
or Red Paste (35% pigment)	1.0

Many other clear and filled flexible compounds have been extruded successfully **(To page 184)**

[3]Relative viscosity approximately 2.00.

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Plasticizer	Specific Gravity 25°/25°C ± .003	Viscosity 25°C, cps	Compatible With	Outstanding Characteristics
Dibenzyl Sebacate	1.055	21-22	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers	Excellent Solvation, Very Low Volatility, Permanence, Good Electricals, Low Temp Flexibility
Dibutyl Sebacate	0.935	7.9	Vinyl Resins, Cellulose Acetobutyrate, Synthetic Rubbers, Rubber Hydrochloride, Polymethyl Methacrylate	Low Temp Flexibility, Excellent Aging Qualities, Non-Toxic
Dimethyl Sebacate	0.986*	3.54 @30°C	Vinyl Resins, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate, Acrylic Resins	High Solvency and Efficiency, Wide Compatibility, Concentrated Source of Sebacyl Radical
Dioctyl Sebacate	0.913	17.4	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate	Excellent Low Temp. Flexibility, Low Volatility, Excellent Soapy Water Resistance, Good Electricals

*30°/20°C

WRITE FOR BULLETIN OR CONSULT CHEMICAL MATERIALS CATALOG PAGES 173-175

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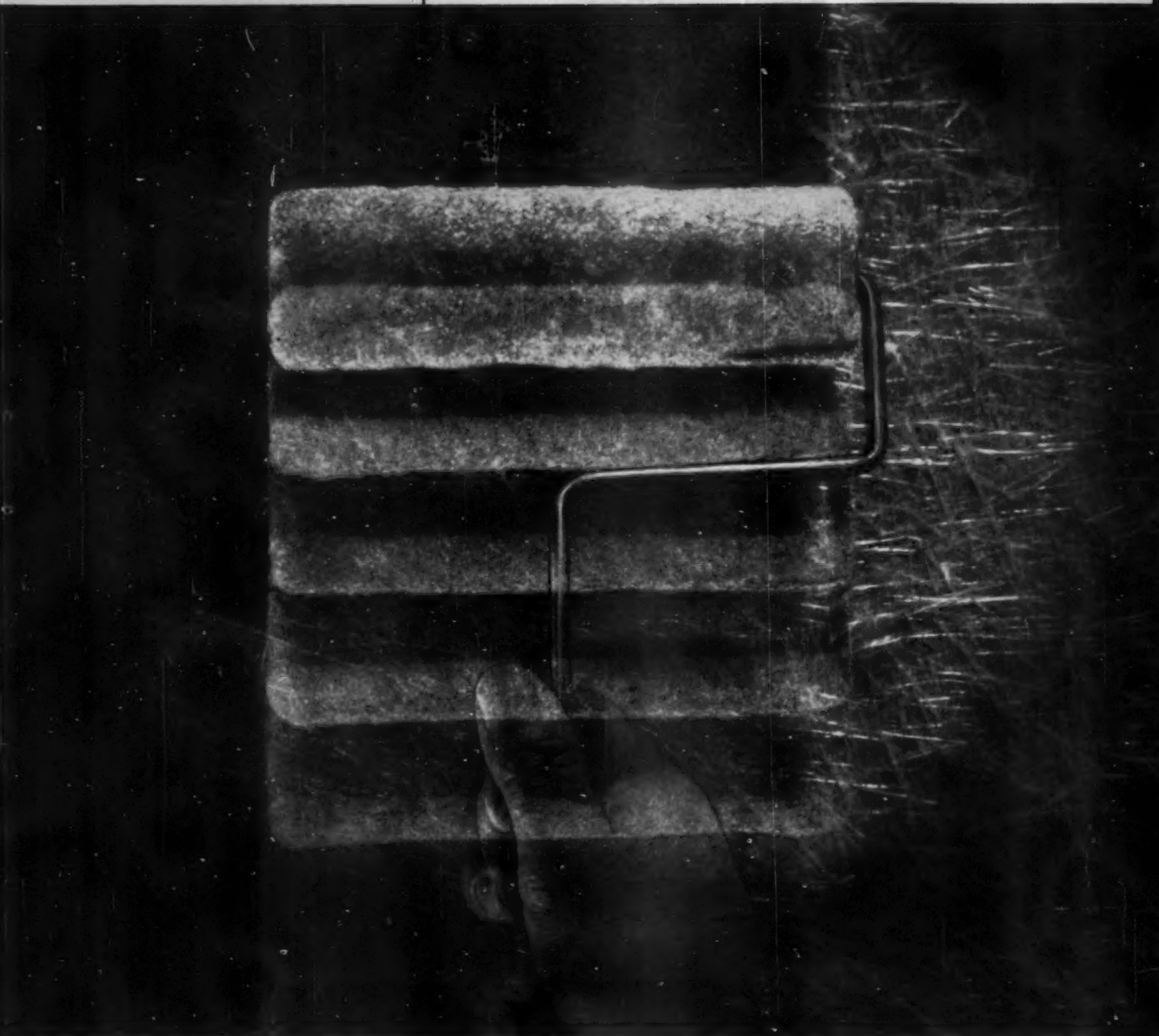
from dry blends with the aid of the vacuum hopper. Two of these



from dry blends with the aid of the vacuum hopper. Two of these are as follows (numbers represent parts by weight):

Flexible tubing

Escambia PVC-3250[4]	100
DOP	85
Basic white lead silicate	9
Titanium dioxide paste (70% TiO_2)	4
Calcium stearate	0.5

Weatherstrip

Escambia PVC-3225[5]	100
DOP	80
Epoxy soy oil	10
Calcium carbonate	80
Barium cadminum solid	2
Stearic acid	0.5
Titanium dioxide	2

Figure 7, p. 108, shows a typical example of the vast improvement obtained with a highly filled weatherstrip compound.

Conclusions

The effect of the vacuum hopper on improving the quality of products extruded from dry blends has been demonstrated with a variety of PVC formulations. Porosity due to air and/or moisture can be eliminated completely even during the most humid summer days. Since the installation of a vacuum hopper on existing equipment is relatively inexpensive, this development should spur dry blend extrusion of PVC products. Studies of dry blend extrusion with the vacuum hopper are continuing.

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3. B. H. Maddock, H. J. Nalepa, B. Zurkoff, "Controlled-pressure (Valve) extrusion," Sixth Annual Signal Corps Wire and Cable Symposium," Dec. 1957.

4. W. M. Mundy, "Vacuum feed extrusion," S.P.E. J. 15, 887, Oct. 1959.—**End**

[4]Relative viscosity approximately 2.40.
[5]Relative viscosity approximately 2.25.

PE film scrap

(From pp. 114-115)

able speed drive, permitting feed rates from 400 to 600 lb./hr., depending on the characteristics of the chopped film. The product is then fed uniformly into a Sprout-Waldron industrial pellet mill.

The pellet mill produces an agglomerate considerably different from what the plastic industry calls a "pellet." The photo on p. 114, compares the "pellet" made on the Sprout-Waldron mill with the conventional extruded and diced pellet. The new pellet is bulkier than the extruded pellet but is considerably denser than the fluffy chopped film. A partial fusion of the material as it is mechanically worked in the mill holds the compressed film together, but the material is not allowed to be fully plasticated.

A schematic diagram of the pellet mill is shown on p. 115. The mill consists basically of a precision machined steel die rotating vertically. Thousands of small diameter holes have been automatically drilled in this die. A set of rough surfaced steel rolls are assembled so the rolls almost touch the inside diameter of the die. As the feedstock enters the die chamber, it gets squeezed between the rotating die and the friction driven rolls. It is thus forced through the holes in the die wall and cut off at controlled lengths by adjustable knives.

It is important to avoid complete fusing of the polyethylene material in the die. This is accomplished either by increasing or decreasing the feed rate to the die as well as by the careful selection of the right die thickness. The retention time in the die with continuous uniform feed governs the amount of fusion.

The agglomerated polyethylene pellet made from film scrap can be used by extruders or compounders, injection molders, or blow molders. It is preferable to have the machines screw fed, since these pellets will not pack tightly enough in the usual feed hopper. By being able to reuse film scrap in Poly-pellet form, molders and extruders can realize up to 20% savings in the cost of raw materials.—**End**

Do's and don'ts

(From pp. 116-124)

blank parts may be decreased by putting a slight rake on the blanking punch, but piercing punches are ground straight across with no shear or rake.

In designing and setting up the die, the stroke of the punch press must be great enough to permit the punch to pass completely through the die ejecting the part, instead of depending upon a succeeding part to push it out as is usually done with paper and cloth reinforced laminates.

Circular sawing

Glass-reinforced laminates are so abrasive that steel saws are not economical even for limited production runs.

Carbide tip saws are sometimes used and a strong tooth form, such as the previously discussed AC30, is required. More so with glass than with other laminates, it is of prime importance to eliminate run out and vibration. Either of these will cause a saw to become dull very rapidly.

If any substantial volume of sawing is to be done, the extra investment for a diamond-to-steel-bonded saw is a wise one and will pay for itself over a period of time. This type saw operates best at speeds of 5000 to 10,000 surface ft./min. and, like all other saws will give longer life if carefully mounted to minimize vibration.

Bandsawing

For extended production, a diamond-to-steel-bonded bandsaw is the most economical. Although expensive, they have been known to outwear more than a hundred ordinary blades. These saws run at around 3 surface ft./min., with just enough tension to prevent slippage. Keep the rollers and guides close to the work to prevent strains which could conceivably result in breakage.

Ordinary bandsaws can be used, although they will become dull enough in a few minutes to cut rather slowly. The life of steel bandsaws can be prolonged five to tenfold by putting 0.0002 to 0.0005 in. of hard chrome plate on the blade. Blades should be of the buttress or skip tooth variety with

8-10 teeth/inch. The amount of set will be about half the blade thickness or around $\frac{1}{64}$ inch. Run the blades at approximately 800 surface ft./min.

Milling

Use carbide tipped tools at from 400 to 800 ft./min. surface speed. The low interlaminar bond strength of some of the glass laminates makes it mandatory to use climb or down milling to prevent delaminating the work. When milling across the laminations, always clamp the work between supports to prevent delamination.

The correct feed rate can best be described as one which is rapid enough to make the tool cut without rubbing and at the same time slow enough to make the tool cut its own way without being forced. Either too slow or too fast a feed will decrease tool life.

Turning

These operations can be performed in ordinary engine lathes at surface speeds of 150 to 200 ft./min. and a feed of about 0.010 in. per revolution. Carbide-tipped tools having a 33° clearance angle; no back rake or lip, and a side rake of 13° are satisfactory. Sharp points on lathe bits wear away quickly, so any bit point should be dressed to a radius as large as the job will permit.

The cutting tool should be set to the center line of the work and the tool holder should be swung to such an angle that the heel of the cutting edge is in advance of the point. This will prevent gouging or peeling and result in the shearing which is desired.

If the work piece is mounted between centers, female centers should be used to avoid delamination at the end. A ball bearing center should be used in the tail stock to minimize frictional heat.

Most ordinary lathe operations can be performed on glass-base laminates, but both internal and external threading operations are generally unsatisfactory because of the brittle nature of the materials which will result in chipped threads. Good part design would avoid any type of external thread on glass base laminates, and internal threads, best done by tapping, should be confined to

pitches small in proportion to the thickness of the part.

If external threading cannot be avoided, threads which have a good appearance can be made on epoxy or melamine by grinding. Their strength is, however, questionable and models should be made and tested before incorporating such parts in a design.

Drilling

The use of copper-clad glass epoxy laminate for printed wiring board application has focused attention on the problem associated with drilling glass laminates. Unfortunately, no hard and fast set of rules can be guaranteed to work well under all conditions.

Using a variety of drill configurations applied by the Cleveland Twist Drill Co. for testing, we have arrived at some conclusions and observations which may prove helpful.

1. Point angles less than 90° will drill faster than those above 90°; however, the holes will not be as clean and, therefore, point angles greater than 90° are recommended for work where inspection standards are high.

2. The useful life of a high spiral drill is nearly twice that of a drill with a regular helix other factors being equal.

3. Drill life with G-11 laminate is on the order of approximately one-third that obtained when drilling G-10 laminate.

4. The efficiency and quality of a drilling operation can usually be judged by observing the material which is being removed. Separate, well defined chips mean the drill is cutting a good clean hole. A powdery residue, naturally, indicates that the drill is not working at top efficiency.

5. In drilling copper clad laminates, a point angle of less than 90 degrees has a greater tendency to raise burrs on the copper than does a wider point.

6. In drilling General Electric Textolite G-10 and G-11 laminates, on which most tests were conducted, a high spiral drill with a 118-degree point, as shown in Fig. 4, was found to be the best, but a different point, probably located somewhere between 90 and 125 degrees, may be found to be considerably more efficient when drilling an equivalent grade that is made by another well-known manufacturer.

Acknowledgments

The information contained in this article has been gathered from many sources over a period of years. In addition to the many major manufacturers of electrical and electronic equipment who have permitted us to see their operation, acknowledgment is made especially to the following independent fabricators whose suggestions and recommendations have proved most helpful: Insulating Fabricators of New Jersey, E. Rutherford, N. J.; Permonite Mfg. Co., Morocco, Ind.; Micarta Fabricators Inc., 5324 Ravenswood Ave., Chicago 40, Ill.; Precision Phenolics Inc., 10031 Franklin Ave., Franklin Park, Ill.; Jaco Products, 2150 St. Clair Ave., Cleveland 14, Ohio; North American Products Corp., 707 Bartley St., Jasper, Ind.—**End**

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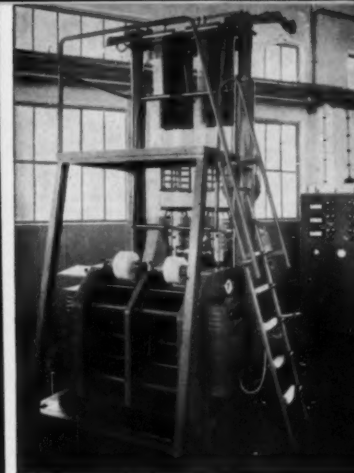

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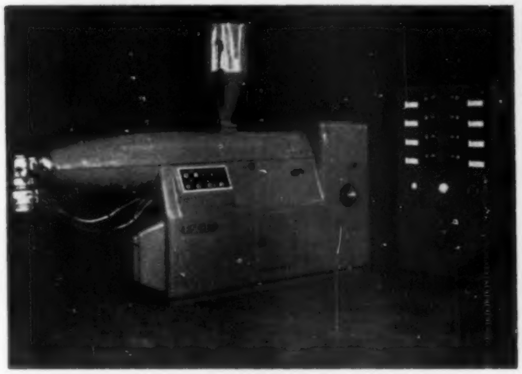

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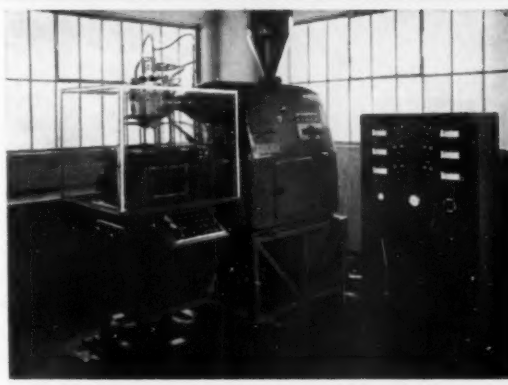

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General formula

(From pp. 127-132)

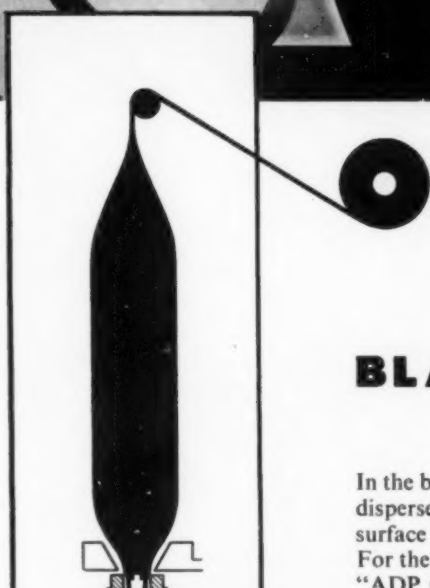
was maintained at test temperature. The specimens were conditioned for 1 hr., removed one at a time, wiped dry, and tested for flexural strength immediately.

Tests at temperatures from −5 to 200° F. were carried out at the Materials Branch, USAERDL. Tests at 250 and 300° F. were carried out at the Materials Laboratory, New York Naval Shipyard. Long term rupture and creep tests on the epoxy laminate were performed at the Forest Products Laboratory as part of a Navy Bureau of Ships project. Creep data on Alathon 10 and Delrin were supplied by Du Pont.

Results

Tables I to V and Figs. 1 to 5 show the experimental data, master rupture and modulus curves, and agreement between the calculated and observed data. The agreement between the calculated and observed results is excellent for all three materials under investigation. This includes time periods from 0.01 sec. to 40,000 hr. for the glass-reinforced epoxy laminate; 100 to 2,000 hr. and stress levels from 200 to 800 p.s.i. for the polyethylene; and 10 to 10,000 hr. for the polyformaldehyde. The results are equally good whether rupture strength, creep, or an environmental factor, such as wet strength is considered. Agreement between calculated and observed data is 11% or better in all rupture data, and in the creep data after the primary creep period is completed.

The determination of T_0, the zero strength temperature, was a problem. Not enough data at elevated temperatures were available so that T_0 could be determined with accuracy. Recourse to extrapolation as shown in Fig. 2 is questionable. Figure 2 shows the final approximately correct values of T_0. These values were obtained by trial and error, and are depicted in Fig. 2 to show that the values that were obtained were not unreasonable. The value of T_0 used for the epoxy glass laminate was the liquidus temperature of the glass fiber, which is about 2900° F. **(To page 198)**



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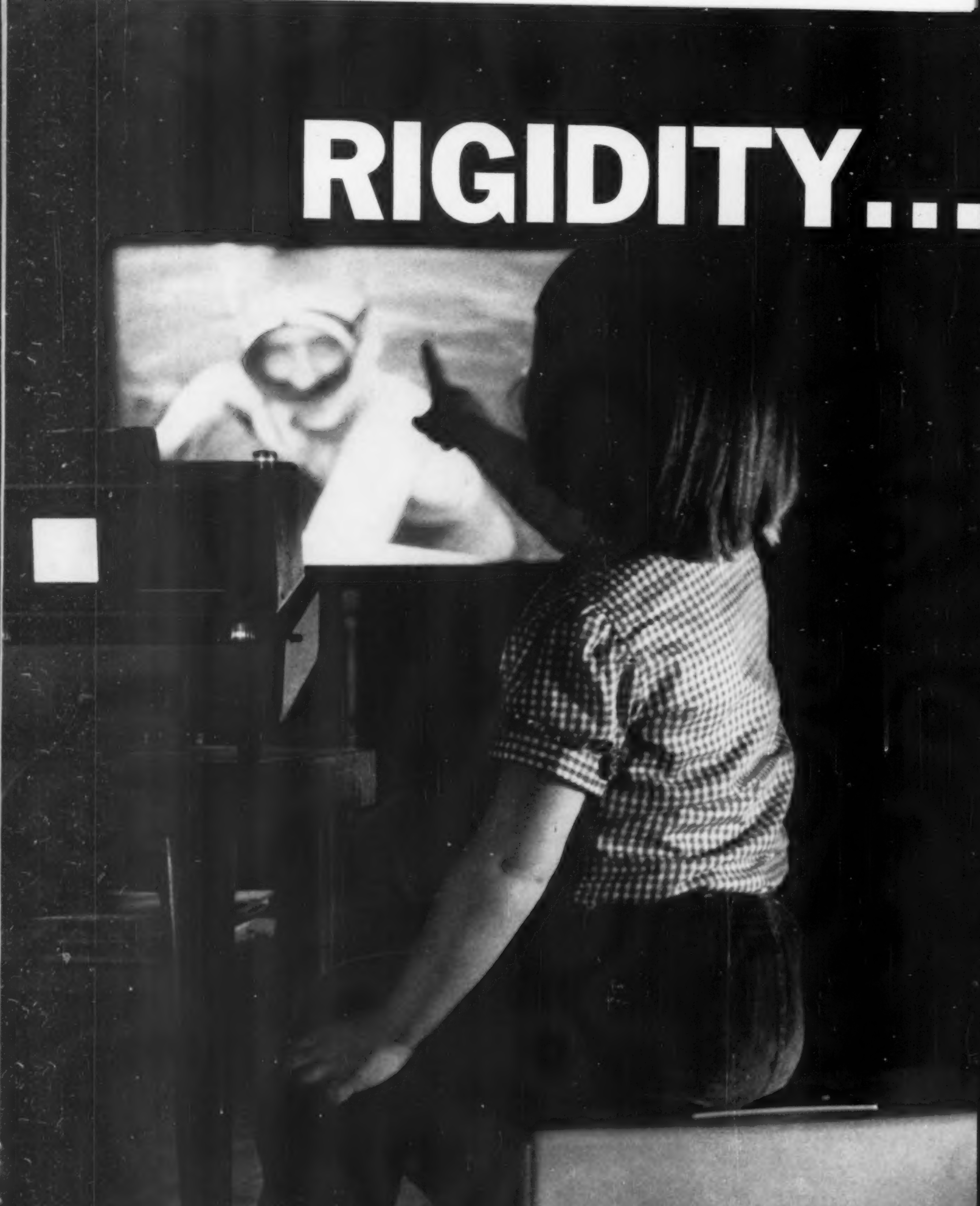

In laminates using fibers other than glass, T_0 would be the melting point of either the fiber or plastic matrix, whichever is higher.

On the surface, it might appear that the agreement is better in the case of the reinforced plastics and polyformaldehyde than in the case of polyethylene. Figure 4 shows, however, that the lack of agreement for polyethylene is evident only during the primary creep period. After this period is over, agreement is excellent. In addition, calculation on a percentage basis tends to accentuate discrepancies in the lower stress levels. For example, the lack of agreement at 100 hr. and 200 p.s.i. is 19.4%, whereas at 100 hr. and 800 p.s.i., it is only 10.5 percent. A study of Fig. 4 shows that the agreement is excellent at the 200 p.s.i. level.

Noteworthy is the fact that the master modulus curves for polyethylene in Fig. 3 become virtually horizontal when the primary creep period is completed. This correlates very well with the creep curves shown in Fig. 4, which also become horizontal in the same period, serves and explain this behavior.

It is not necessary to perform tests in order to draw the entire master curve when only certain types of specific information are required. For example, a hypothetical question might arise as follows: At what temperature, T_1, should a tensile static test be performed on Delrin in order to determine its rupture stress at 150° F. after 10,000 hours? Since the *K* values for the static test and the long term test are identical,

$$K = \frac{T_0 T_1}{T_0 - T_1}(20 + \log t_1)$$

$$= \frac{T_0 T_2}{T_0 - T_2}(20 + \log t_2)$$

T_0 = 900° F. absolute
T_2 = 150° F. = 610° F. absolute
t_2 = 10,000 hr.
t_1 = 10^{-6} hr. (the steady-load-time equivalent)

$$\frac{(900)(T_1)}{900 - T_1}(20 + \log 10^{-6}) = \frac{(900)(610)}{900 - 610}$$

$$\times (20 + \log 10{,}000)$$

$$T_1 = 678^\circ \text{ F. absolute} = 218^\circ \text{ F.}$$

This relationship (Eq. 3), both

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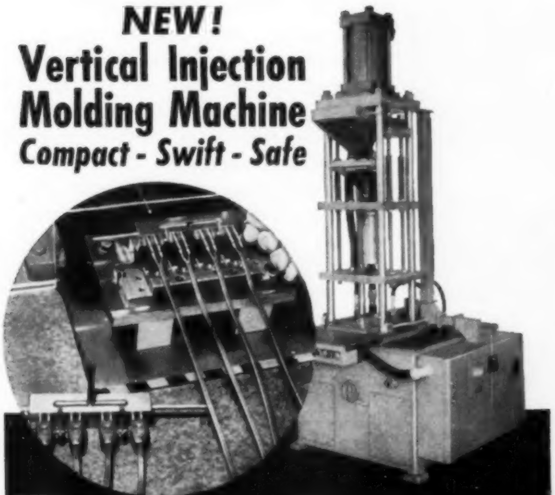

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in its general and special forms, accurately describes the tensile, compressive, and flexural properties of plastics. Equation 7 should, therefore, also hold true for special shapes of various materials, such as pipe.

Regardless of the types of stresses set up, whether biaxial, hoop, or otherwise, in the final analysis the mode of failure is by separation of the molecules in the material. If the stresses on an item are so complex that they cannot be calculated readily, then the item itself might be tested for the peculiar property desired. In the case of pipe, this could be burst strength. A master curve of burst strength versus K drawn from short-time burst tests at elevated temperatures would enable the long-term properties to be calculated readily. If Barlow's law holds, then only the tensile-stress master rupture curve need be investigated.

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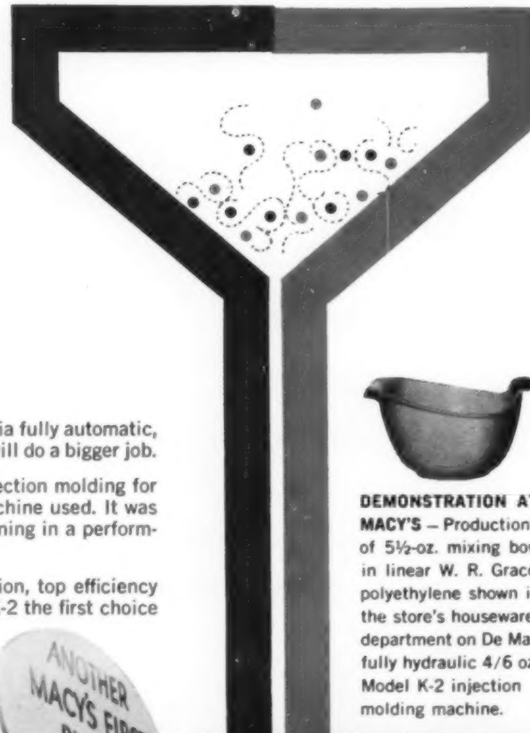

DEMONSTRATION AT MACY'S – Production of 5½-oz. mixing bowl in linear W. R. Grace's polyethylene shown in the store's houseware department on De Mattia fully hydraulic 4/6 oz. Model K-2 injection molding machine.

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Oxirane and iodine

(From pp. 135-144)

enough to remain in the vinyl compound. Further, in the presence of other plasticizers such as DOP, the polymer solubility in the total system is increased, thus reducing exudation tendencies.

The changes in other properties are consistent with those expected from the chemical change of the plasticizer. Thus, as oxirane destruction proceeds, the plasticizer becomes less efficient in terms of higher modulus and hardness figures. Ultimate elongation and tensile strength are decreased by the presence of an incompatible plasticizer portion. Brittle point temperatures rise rapidly as plasticizer crosslinking proceeds.

The removal of oxirane rings results in a lowering of heat stability and stabilization due not only to the decrease of oxirane groups, but also to the creation of less stable ether linkages. This lowering of heat stability is best shown in systems containing the epoxy plasticizer at the conventional stabilizer levels. At a 50 part level, only minor differences in color degradation could be shown even after 12 hr. in a mechanical convection oven at 350° F. This observation emphasizes the nonquantitative aspect of the epoxy stabilization mechanism.

These negative effects of partial oxirane destruction on the general performance of the epoxidized soybean oils stress the importance that must be attached to the efficiency of epoxidation rather than to extent of saturation.

Initial color vs. color stability

In a competitive plasticizer market, much significance is placed on the color of the commercial product. Recent production of epoxidized soybean oils has ranged from a maximum color value of Gardner 2 to less than Gardner 1 into the APHA scale. Thus, the production of an epoxy plasticizer with a 75 to 125 APHA color (less than Gardner 1) is no longer uncommon.

These color levels are initial values and do not indicate what, if any, color degradation will occur on heating the product during vinyl processing. The various epoxidized soybean oils measured for loss of oxirane (Table IV) were also examined for color stability up to 90 hr. at 350° F. Table VIII, p. 144, shows that all products degrade rapidly to colors entirely out of proportion to initial levels. Fine differences of initial APHA color levels are obscured entirely by subsequent in-process heat exposure. No conclusions as to color versus oxirane stability may be drawn.

Acid value vs. oxirane stability

Although the presence of acidic groups accelerates oxirane destruction, the absence of such groups does not assure a low order of such destruction (Table IV). However, in purchasing optimum quality epoxy plasticizers, the vinyl processor is well advised to insist on low acidity products to reduce significance of this factor from stability considerations.—**End**

THE PLASTISCOPE*

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 39)*

April 1960

Construction for plastics

The table printed herewith, provided by the Manufacturing Chemists' Assn., gives a quick look at the importance of plastics in the construction program now completed or under way in the chemical industry for the years 1959-1961. The figure of $450 million allotted to plastics is really an understatement, since a good portion of the petrochemicals division expenditure is ticketed for plastics. According to the association, the total number of construction projects for plastics and resins is listed at 128; petrochemicals, 35; laboratories, 108.

A continuing upswing in laboratory construction is significant especially as it pertains to plastics. The chemical industry's total research budget last year topped $600 million. The three year construction figure of $220 million shows a substantial rise over the $157 million in 1959 and the $107 million announced the year before.

Texas is the number one state of the three-year period for chemical construction with a total of $792.5 million, and Louisiana is second with $370.9 million. Total chemical production and research facilities costing $1.657 billion will be constructed during 1960 and 1961. This includes construction already begun and that expected to be completed before 1962.

*Reg. U.S. Pat. Off.

MCA chemical industry construction survey (1959-61)

Category	*Planned*	*Under construction*	*Completed*	*Total*
		(millions of dollars)		
Fertilizer chemicals	31.5	43.8	41.1	116.4
Inorganic chemicals (general)	62.9	256.4	366.9	686.2
Laboratories	32.6	126.3	61.6	220.5
Metals	6.9	15.7	63.3	85.9
Organic chemicals (general)	116.6	322.7	235.2	674.5
Petrochemicals	68.7	70.7	315.1	454.5
Plastics and resins	90.8	183.2	176.0	450.0
Synthetic rubber	—	43.7	1.4	45.1
Synthetic fibers	29.0	60.3	12.0	101.3
Miscellaneous	46.4	48.9	71.7	167.0
TOTALS	485.4	1,171.7	1,344.3	3,001.4

Microporous plastics

Water-repellent clothing claimed to have the breathability of ordinary fabrics is expected to be one of the first major uses of microporous plastics made by ESB-Reeves Corp., a company formed last summer and owned jointly by Electric Storage Battery Co. and Reeves Brothers Inc. The process for making these porous plastics, originally developed by ESB to make improved battery separators, is expected to widen the plastics' market base since any thermoplastic sheet material can be processed to transmit vapor while holding back water, according to the company. Besides PVC, laboratory and pilot plant work is being done on nylon, polyethylene, polypropylene, various styrene and acrylonitrile polymers, fluorocarbons, etc.

The porosity is produced by blending the resin with starch and processing this mixture by extrusion or calendering. The resultant sheet material then goes into boiling water where the starch particles swell, produce an interconnected cell structure, and expand the plastics sheeting. An acid bath or enzyme treatment then turns the starch into sugar which goes into solution and leaves the plastics sheet honeycombed with tiny pores. After the starch has been leached, the material shrinks to its original size and is now porous. The porosity of the plastics material can be controlled and depends on the ratio of starch to resin and on the particle size of the starch, the company states.

Apparel, such as rainwear, snow suits, and protective clothing of all types will probably be marketed by Reeves Brothers this year. Other similar uses include tarpaulins, sleeping bags, shoe uppers, etc. Reeves also recently started the lamination of urethane foam to plastics and textiles. Interesting combinations of such laminates and microporous materials are under evaluation. Other promising applications are said to be adhesive bandages; filters for removing impurities from water or other solutions; permeable plastics sheets in blood oxygenators (artificial lungs); and in so-called solar stills to separate pure from brackish water.

ESB-Reeves has just opened a special applications laboratory in Glenside, Pa., to centralize research and development activities especially for uses other than textiles. It is anticipated that the process will be licensed to companies who want to extend the use of these materials beyond the fields in which the two parent companies—ESB and Reeves Brothers—are active.

Another method of making a microporous sheeting was developed by United Shoe Machinery Corp. and **(To page 206)**

THE PLASTISCOPE

(From page 204)

is now used by Rogers Corp., Rogers, Conn. This process is built around one basic machine in which a uniform layer of specially compounded vinyl powder is laid down on a moving web, heated to sinter the vinyl particles together, and then cooled prior to winding at the machine's exit end. When the sintered vinyl is bonded to a backing material, the adhesion is obtained in the same machine. The physical properties of the material, designated Poron, can be varied by changing the PVC formulation.

Poron was developed in order to provide an inner sole for shoes that would have all the advantages of leather but none of its disadvantages. According to Rogers, the new material is 20 to 40 times more porous than leather when new, and aging does not appreciably change the porosity. Leather will harden, pack down, and become brittle, but the plastics material is said to remain flexible, will not shrink, crack, or support mold growth. Because of their porosity and the speed with which they disperse moisture, Poron insoles are said to afford a drier and more comfortable surface for feet; and since they do not shrink or curl, these insoles contribute towards preserving the original shape of footwear, the company states. Apart from inner soles, the new material is expected to find application as sweatbands, belt linings, backing strips on watch straps, filters, surgical dressings, and close-to-the-skin athletic gear.

Rogers produces Poron in continuous sheets, 11 in. wide, in a wide range of colors.

Push-lock inserts

A line of push-in type inserts and studs for use in molded plastics parts has been introduced by Fastener Products Inc., Norwalk, Conn. The inserts and studs are merely pressed into a molded-in or drilled hole and locked in one operation. Rotation and pull-out strength are said to be comparable to those of molded-in inserts and studs. Savings are possible because the new fasteners eliminate open press time, floating inserts, tapping operations, and positioning of inserts in molds.

Fire retardant resin

A new epoxy casting resin which is said to be fire retardant and may be cured at room temperature has been introduced by Emerson & Cuming Inc., Canton, Mass. Because of its low thermal coefficient of expansion and high heat stability, large embedments are said to be possible. It is stable over a temperature range of −100 to 350° F. Called Stycast 1231, the new resin can be color coded to specification but normally is supplied in black.

Promotes decorative laminates

A joint campaign for coordinated production and merchandising of Micarta decorative plastic laminates has been launched by Westinghouse Electric Corp.'s Micarta division and U. S. Plywood Corp., distributor of decorative plastic laminates made by Westinghouse. Expedited deliveries, intensified quality control, an augmented line of patterns, colors, and sizes, and a new pricing policy are major aspects of the plan.

Laminated tubing. Thick-walled paper based Micarta tubing is now available from the Westinghouse Electric Corp. for electrical applications such as lightning arrester barriers and fuse tubes. For such uses it is said to be equivalent in performance to cloth-based materials. Grade 20005 tubing is guaranteed by Westinghouse to be crack-free in wall thicknesses up to 1 inch. It can be machined with conventional equipment and can be tapped or threaded with as many as 28 threads per inch, the company states. The new material conforms to performance requirements specified for molded tubing of NEMA grade XXX and Mil-P-79B type PBE. Moisture absorption is less than 1%, compressive strength is 21,000 p.s.i., and tensile strength is 12,000 p.s.i. Short-time dielectric strength is 500 volts/mil and dissipation factor is 0.045 at 1 megacycle.

Computer control for plastics

The new digital computer used for control of chemical processes at the Goodrich plant in Calvert City, Ky., brought results "beyond expectations" in the production of vinyl chloride and acrylonitrile, according to company executives.

The computer is a Thompson-Ramo-Wooldridge RW-300 digital computer. It scans, logs, and controls a new vinyl chloride process being carried on at the plant. The computer, in sequence, runs a test problem, reads a special clock, and then determines if it is time to perform any of its duties. This operation is carried on 24 hr. a day, 7 days a week. The new computer makes it possible for a company to apply its technical inventiveness and imagination with rapidity on a scale never before dreamed possible with previous systems or equipment available in a chemical plant.

It is not a labor-saving device but is designed to improve quality and efficiency. It helps to give faster, more accurate and more comprehensive control of the manufacturing process than the most expert manual control. If, for example, a product gets too hot or flows too fast, or the pressure gets too high, the computer will correct or shut off the operation. In other words, it makes a better overall quality product without wasting material.

PE for bags

A major development in flexible packaging is the introduction of a new linear polyethylene resin that produces a film with a burst strength said to be superior to conventional polyethylene or kraft multiwall bags. Called Marlex TR-101, the resin was developed by Phillips Chemical Co., Bartlesville, Okla. According to the company, 7-mil bags of Marlex TR-101 have demonstrated a burst strength 2½ times that of 10-mil conventional PE, 38% more tensile strength, and 25% improved moisture barrier properties. A typical 50- (To page 208)

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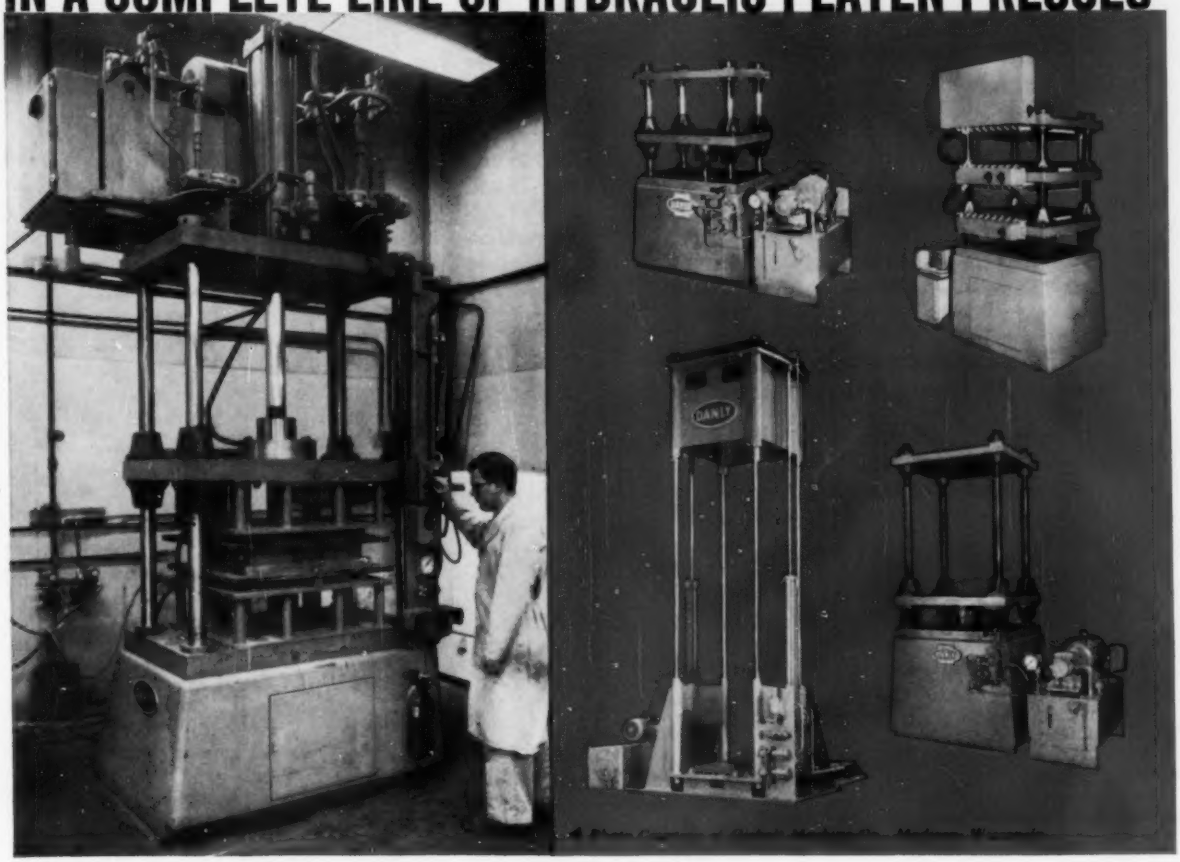

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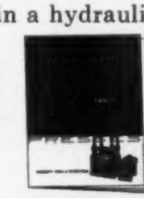

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DANLY MACHINE SPECIALTIES, INC., 2100 S. LARAMIE AVE., CHICAGO 50, ILLINOIS

(From page 206)

lb.-size bag costs 20¢, as against 22¢ for 10-mil polyethylene. Five-mil bags made of TR-101 resin, costing 16¢, have been found superior in strength and moisture resistance to PE-coated multi-walls while costing the same amount, Phillips states. Weight savings realized from the thinner film come to 800 lb. over kraft paper in a carload lot of about 1500 bags and as much as 240 lb. over conventional PE.

Phillips estimates that leading bag producers will make 12 to 15 million bags from the new resin in the next 12 months. Several leading companies have produced bags for test shipments of fertilizers, resins, dried milk products, detergents, seeds, refractory cements, and other materials. According to Phillips, cross-country test shipments of over 10,000 filled TR-101 bags showed a breakage record of less than one half of one percent.

The bags are sealed on standard polyethylene-sealing equipment, or sewn on paper equipment. Bag production rates are said to be as great or greater than standard PE in all phases. The film can be produced in white or a variety of colors. Bags can be printed in multiple colors.

Cross-linked polyethylene

Nonexclusive licenses under General Electric's U. S. patent No. 2,888,424 directed to the manufacture of filled, chemically cross-linked polyethylene will be made available on reasonable terms according to an announcement by S. L. Brous, marketing manager of the company's Chemical Materials Dept. at Pittsfield, Mass.

The patented compositions were invented in General Electric's Research Laboratory at Schenectady, N. Y., according to Dr. C. G. Suits, vice-president and director of research, and represent an improved class of materials which exhibit good tensile strength, particularly at high temperatures. Hot-strength films and tapes, molded industrial parts, and wire and cable insulation and piping are among the many applications for which these new materials are especially suitable.

General Electric is also authorized by Hercules Powder Co. to grant nonexclusive license rights under Hercules' U. S. patent No. 2,826,570 to any licensee of General Electric under its patent No. 2,888,424 desiring such a license, according to the company. The Hercules patent is directed to unfilled, chemically cross-linked polyethylene.

For additional information write Mr. S. L. Brous, Chemical Materials Dept., General Electric Co., Pittsfield, Mass.

Kordite in Japan

A joint venture to manufacture and sell plastic film products in the Far East is being planned between The Kordite Co., Macedon, N. Y., and the Mitsubishi Petrochemical Co. Ltd., Tokyo, Japan.

A Kordite official said that the growth of plastic packaging film production and marketing during the next 10 years in the Far East will probably exceed that expected in the U. S.

Kordite has branch plants in Jacksonville, Ill. and Woodland, Calif., and recently established several foreign licensees in Europe. The Japanese representatives recently toured Kordite plant facilities and visited the Bond Div. of General Baking Co. which collaborated with Kordite in pioneering the use of automatic polyethylene wrapping of baked goods.

Makes plastic-coated aerosols

Formation of Wheaton Plasti-cote Corp., with executive and sales offices in Millville, N. J., and a factory in Mays Landing, N. J., for the manufacture and sales of plastic-coated glass containers for aerosol products, has been announced by Frank H. Wheaton Jr., president of the Wheaton companies. In addition to this line, the new company will carry out basic development work to expand the use of plastics coating of glassware for use in the laboratory, and application of coatings of various materials for the production decoration, or insulation of other materials and devices.

The new corporation was formed in order to permit Wheaton Plastics Co. to diversify further into the field of plastics packaging. Robert N. Allen, formerly of Wheaton Plastics, was named vice-president and general manager of Wheaton Plasti-cote.

Improved phenolic compound

A new asbestos-reinforced phenolic molding compound, said to have a heat distortion point of over 500° F., has been developed by Rogers Corp., Rogers, Conn., primarily for gears, electrical switchgear, and control parts. The new compound has the following properties: impact strength, 2.5 ft.-lb./in. of notch; compressive strength, 12,000 p.s.i.; tensile strength, 6000 p.s.i.; arc resistance, 165 seconds; average ignition time (flame resistance), 340 seconds—all average values, according to the company.

Affording a low bulk factor for this class of material, the reinforced phenolic, designated RX 495, is said to mold to a high luster finish with a mold shrink of only 0.001 in./in.

PE for greaseproofness

A new polyethylene coating resin, Petrothene 205-15, is now available from U. S. Industrial Chemicals Co. This new PE resin (density 0.924, melt index 3.0) is said to adhere well to a wide variety of substrates and to provide 100% greaseproofness at a lower coating weight than other resins of similar melt index and density. According to the company the good coating characteristics of the new resin extend to non-porous substrates such as cellophane and foil as well as to porous substrates.

More RP boats in 1960

Builders of fibrous glass boats who experienced a 50% sales gain in 1959 conservatively predict a further advance of 20% in 1960. Between 120,000 and 130,000 fibrous glass boats were sold in 1959, and the emphasis was on bigger boats using 90% more raw materials to **(To page 210)**

(From page 208)

build 50% more hulls. Forecasting total industry production of 150,000 RP boats this year, Robert S. Morrison, president of the Molded Fiber Glass Boat Co., Union City, Pa., pointed out that only a temporary shortage of fibrous glass will keep production from exceeding this figure. In 1960 this trend to bigger boats is also evident in the lines of almost all builders, according to Mr. Morrison, whose company produced nearly 10,000 boats in 1959 and has a capacity to turn out 15,000 boats in 1960.

Gordon Research Conferences

The Gordon Research Conferences will be held June 20 to 24 at Colby Junior College, New London, N. H. The subject of the first meeting will be "Structures and Properties of Elastomers." The second will be on adhesives.

Attendance is by application and is limited to 100 at each conference. Applications should be submitted two months prior to the conference and addressed to W. George Parks, Director, Dept. of Chemistry, University of Rhode Island, Kingston, R. I. After June 13, mail should be addressed to Colby Junior College.

Vinyl for heating unit

Winter freeze-ups of automobile engines can now be eliminated by using a durable vinyl insulated heating wire unit, mounted on a wooden frame, and placed beneath the auto engine. Plugged into a standard 110/120-v. house current outlet, the unit provides sufficient localized heat to prevent ice formation in the engine's cooling system. B. F. Goodrich supplies the Geon vinyl insulation.

The heating wire unit, called Thermwire, made by Edwin L. Wiegand Co., Pittsburgh, Pa., comes in hot wire lengths of 160 ft. with an attached 10-ft. cold lead. The wire can be mounted on a wooden frame in zig-zag fashion, then placed on the floor of the garage beneath the automobile engine. Thermwire heating units are also being installed under driveways to prevent icing and eliminate the need for winter salting.

Light colored phenolic resin

A new phenolic resin for use in light-colored compounds based on natural rubber and styrene-butadiene copolymers has been developed by the Plastics Div. of National Polychemicals Inc., Wilmington, Mass. Called Poly-Phen S-128, the new resin is said to impart substantially lighter color and better color stability than resins presently on the market, while also providing good reinforcement.

The new material is being marketed in uncatalyzed flakes and powder, as well as a catalyzed powder. The company recommends Poly-Phen S-218 especially in the compounding of composition soles, top lifts, etc.

Dow to produce nylon-6 for textiles

Plans for the construction of a plant to manufacture nylon-6 at The Dow Chemical Co.'s James River Div. have been announced. The multi-million dollar facility will have an (To page 212)

Kenneth A. Spencer dies

Kenneth A. Spencer, chairman of the board and founder of Spencer Chemical Co., died Feb. 19 in Miami Beach, Fla., from complications following a heart attack. He was 58.

Born in Columbus, Kan., he moved to Pittsburg, Kan., where his father acquired control of the Pittsburg & Midway Coal Mining Co. He succeeded his father as president of that company and retained that office until his death.

In 1941 the federal government accepted this coal company's plan to establish a synthetic nitrogen plant in Kansas, which became the Military Chemical Works that constructed and operated the Jayhawk Ordnance Works. At the end of World War II, Mr. Spencer converted Jayhawk to the production of nitrate fertilizer for export by the CCC. In 1946 with the financial backing of J. H. Whitney & Co. of New York, he acquired the plant and it became the Spencer Chemical Co. In the 14 years since 1946, the company grew from one plant to six; sales grew from $12 million to $60 million.

Mr. Spencer's company was one of the first of the various companies who obtained licenses from ICI to start production of high-pressure polyethylene. Later a license from AKU was obtained for the manufacture of nylon-6. The company is now preparing to place polypropylene on the market in a joint arrangement with Humble Oil and Enjay. Other chemicals sold by Spencer are nitrogen products for fertilizer, nuclear fuels, dry ice and carbon dioxide products, argon, methyl alcohol, etc.

Mr. Spencer was a founder and member of the board of governors of Midwest Research Institute and a member of the Business Advisory Council to the U. S. Secretary of Commerce. He was on the board of directors of AT&T, Armco Steel, Goodyear, International Harvester, National Coal Assn., and MKT Railroad.

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initial capacity of 12 million lb. per year of filament yarn, primarily for use in tire manufacture. Zefran acrylic staple fiber operations, started at James River in mid-1958, currently employ 450.

Caprolactam, the principal raw material used in the production of nylon-6, will be obtained from Dow Badische Chemical Co., a Dow associated company with facilities in Freeport, Texas.

How to improve blown PE film

Clarity and gloss of blown film can be substantially improved by installing a sleeve-like annealing chamber or "chimney" around the blown film tubing between the extruder die and the air ring chamber, according to information recently released by U. S. Industrial Chemicals Co. The "chimney" can be made of any simple inexpensive material such as wood, glass, or insulated metal. It may be constructed in two sections, or hinged, permitting installation during the extrusion process without rupturing the film "bubble."

To obtain optimum film properties, the height of the annealing chamber is an important factor. A data sheet graphically illustrates the relationships between the various physical properties of the film and the height of the "chimney." The theory of how the annealing chamber works is also explained.

Copies of the annealing chamber data sheet may be obtained from U. S. Industrial Chemicals Co., Div. of National Distillers & Chemical Corp., 99 Park Ave., New York 16, N. Y.

Cast acrylic sheets

Thin gage cast acrylic sheets for instrument dial facing are now available in 0.015, 0.020, 0.030, 0.040, and 0.050 in. from Cast Optics Corp., Hackensack, N. J. Called Evr-Kleer, the sheets can be supplied transparent, translucent, or opaque, and can be custom cast to insure proper light transmission and reflected color.

Cast acrylic sheets are said to be superior in resistance to warpage due to heat or moisture, and to have excellent weathering characteristics.

RP prize winners

A colorful, smartly-styled bowling alley bench and ball-rack of fibrous glass reinforced plastic was named grand prize winner of an exhibit of new products at the 15th annual conference of The Society of Plastics Industry's Reinforced Plastics Division. The exhibit contained some 350 RP products, ranging from huge missile thrust chambers and radomes to household trays and fishing rods. Prizes were awarded on the basis of originality of application or design, material selection, color, utility, moldability, and appearance. The prize-winning bowling alley bench was made by Brunswick-Balke-Collender Co., Chicago, Ill., which also captured a first prize in the sporting goods category with another new application, a bowling ball return rack and hood.

First prize winners in other categories were: *Aviation:* fin tip beacon housing for aircraft, Cessna Aircraft Corp., Wichita, Kan.; *Building construction:* laminated decorative panel, Swedlow Inc., Los Angeles, Calif.; *Military:* jet engine compressor section, Fairchild Plastics, Copiague, N. Y.; *Consumer products:* home washtub, American Insulator Corp., New Freedom, Pa.; *Materials handling:* fertilizer tank, Molded Fiber Glass Body Co., Ashtabula, Ohio.; *Process and industrial equipment:* molded circuit breaker, Firmaline Products Inc., Midland Park, N. J.; *Transportation:* truck tractor cab of hand layup fabrication, General Tire & Rubber Co.'s RP Div., Marion, Ind.; *General:* molded wastebasket, Armored Plastics Co., Toledo, Ohio.

New nylon products

Massive nylon symmetrical shapes weighing up to 400 lb. and measuring up to 36 in. in width, 2⅝ in. in thickness, and 102 in. in length, are now being produced by The Polymer Corp., Reading, Pa. The new shapes are expected to expand the use of nylon in the metalworking and manufacturing fields for such applications as tooling fixtures, wear plates, large rollers, etc., where nonferrous metals or stainless steel materials were previously used. According to the company, these parts may now be made less expensively from nylon shapes.

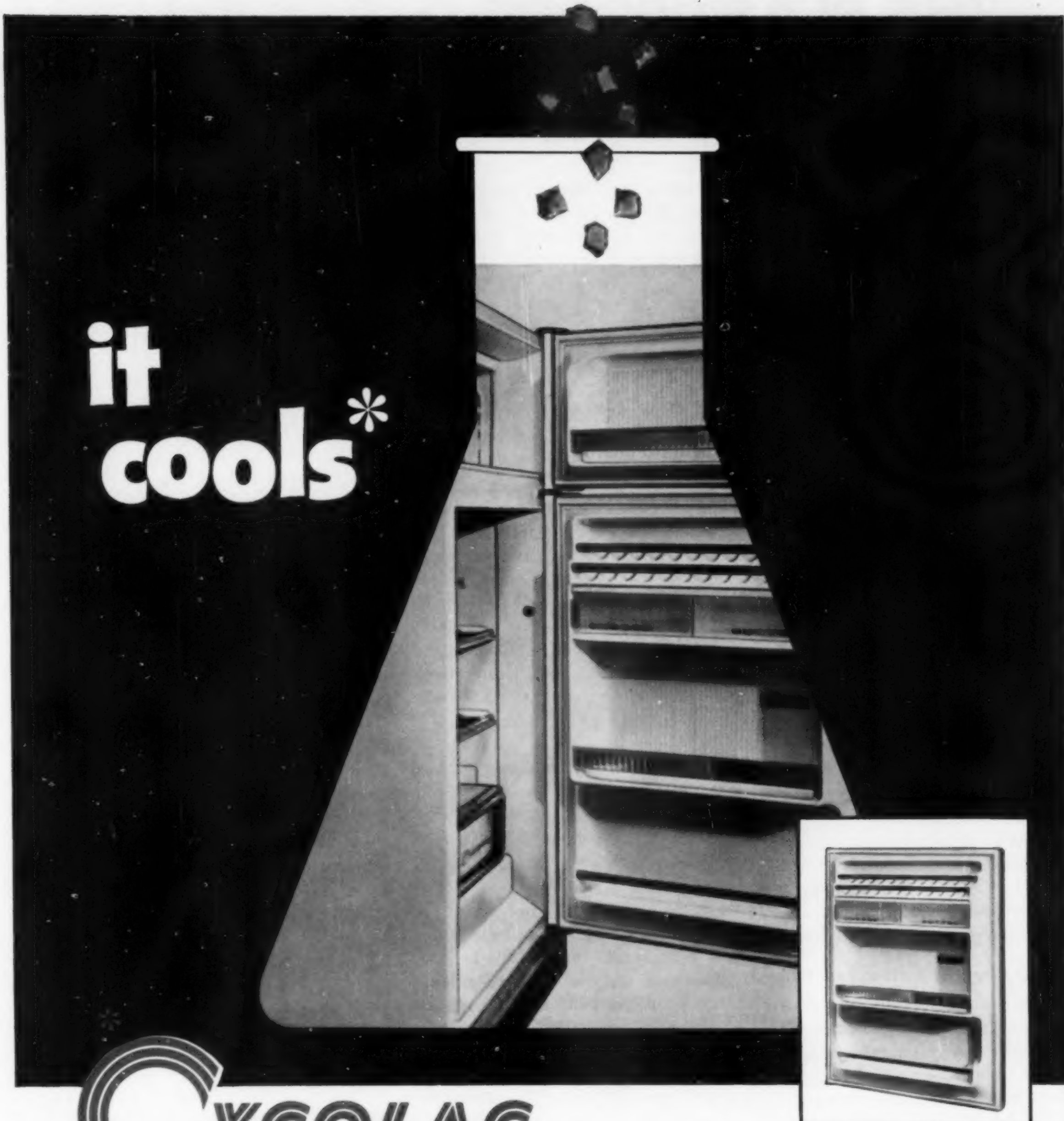
Polymer Corp. has also introduced an armored pressure hose consisting of a braided outer jacket and a nylon inner tube. Known as Nylaflow pressure hose, it is said to have a wall thickness less than one-half of rubber hose with equivalent burst strength. The new product is said to be unaffected by flammable and non-flammable hydraulic fluids, has low Freon permeability and excellent resistance to caustics and almost all organic solvents. It is non-toxic, noncorrosive, and fungus-resistant, the company states. According to the company, the hose retains good flexibility and toughness in temperatures from −65° F. and intermittently in temperatures up to 300° F.

Two types of the new nylon hose are presently available with recommended maximum operating pressures of 1250 and 2000 p.s.i. (5000 and 8000 p.s.i. burst strengths, respectively). The new product is intended for hydraulic, lubrication, fuel and oil, hot paint, solvent, water, and high pressure pneumatic lines.

Perforated sheets

PVC and polypropylene perforated sheets have been introduced by Dorak Products Corp., New York, N. Y. Called Filter-Mesh, this sheet material offers highly chemical resistant strainer elements or filter cloth for use in conjunction with extremely corrosive acids, alkalis, solvents, and chemical salt solutions.

The unplasticized PVC perforated sheet is said to be suitable for contact with strong oxidizing chemicals at temperatures up to 168° F., while the PP offers good general chemical resistance with exceptional properties in solvent service and is suitable for tempera- **(To page 214)**


it cools*

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tures up to 250° F. Both materials are available in 40, 34, 26, 18, 14, 10, 6, and 5 mesh perforated sizes and can be supplied in rolls up to 100 ft. in length. The material is also said to offer excellent electrical and thermal insulation properties combined with physical stability and decorative appearance. It can be fabricated by either solvent cementing or heat sealing, the company states.

International Congress with macroPlastic

Simultaneously with macroPlastic International plastics show to be held at the Croeselaan exhibition site at Utrecht, the Netherlands, October 19 to 26, 1960, the International Congress on the technology of plastics processing will take place in Amsterdam October 17 to 19, 1960.

The Congress program committee is inviting submittals for lectures by experts from all over the world. Summaries or abstracts of proposed lectures in either English, French, or German should be sent to Secretary of the International Congress on the Technology of Plastics Processing, c/o N.V. 't Raedthuys, Tesselschadestraat 5, Amsterdam, Holland.

Lower freight rates for film

A reduction of 15% on less-than-carload shipments of plastics film or sheeting, transparent or translucent, other than cellulose, combined or not combined with paper or paperboard, has been posted by Lifschultz Fast Freight. The new rates result because Class 55 now applies. However, the new rate does not apply if the material is printed, processed other than cut to size, or is not in line with certain length and other provisions.

Guarantees PE toys

An innovation in toy merchandising, a one-year guarantee against breakage backed up by free repair or replacement of damaged goods, has been introduced by Eldon Mfg. Co., Los Angeles, Calif., at the Toy Fair in New York, N. Y. The guarantee applies only to a group of nine toys made of Celanese Plastic Co.'s Fortiflex high-density polyethylene. The retail price range of these toys is from $3.00 to $10.00. The line includes relatively large trucks, fire engines, etc., some of which can be ridden.

Fluorocarbons

Teflon rods. Molded rods 30 in. long, made of pure Teflon and Miplon #215 (glass fiber-filled Teflon) in ⅛, ¼, ⅜, and ½ in. diameters are available from Modern Industrial Plastics Inc., 3337 N. Dixie Dr., Dayton 14, Ohio. According to the company, tensile strength and elongation are superior to those of extruded rod, and optimum density and uniformity are obtained. Miplon rod is said to have a minimum tensile strength of 2000 p.s.i. and an elongation of 200 percent.

Teflon-aluminum combination. A new gasketing and mold release material said to combine the best features of aluminum and Teflon has been developed by American Machine & Foundry Co.'s Commercial Development Div. Called AmFoil, the new product consists of aluminum foil with Teflon resin cast on one or both sides, then fused at 900° F. to form a permanent bond. Foil thicknesses range from 0.0002 to 0.012 in., and the Teflon coatings range from 0.00006 to 0.001 inch. The material is used in electronic applications; as a separator and mold-release film in the plastics industry, and an extra-thin gasketing. Other uses may be as a clothing interliner for arctic and tropical wear, for bottle and container cap liners, as well as in cryogenics research and instrumentation.

TFE for manned missiles. A thin skin fabricated from Teflon TFE-fluorocarbon resins may have a potential use as an expendable heat shield in manned high speed rocket flights, according to studies made by Dr. John C. Siegle and Dr. Paul H. Settlage of Du Pont; at extremely high temperatures, it was found, the TFE resins turn directly into gas, and a tremendous amount of heat is absorbed during this process. The flow of this gas back along the heated surface helps dissipate the heat further.

The poor heat transmission of the underlying plastic limits the vapor formation to the surface area. Since heat does not cause the plastic to melt-flow, the skin retains enough strength to withstand the crushing force of the earth's atmosphere, thus preserving the aerodynamic shape and preventing a breach in the insulation wall.

According to Du Pont, a Teflon coating less than one-third of an inch thick could provide protection for at least 2 min. without heating a supporting metal sheet much beyond room temperature.

Sockets. A new four-contact subminiature tube socket and transistor socket has been introduced by Fluorocarbon Products Inc., a Div. of United States Gasket Co. Designated No. SJ-424 and designed especially for Jetec type sockets, they feature a Teflon body for compression mounting into a metal chassis. This is said to reduce assembly costs and rejection due to faulty assembly.

British resins. Polytetrafluoroethylene resin manufactured by the Plastics Div., Imperial Chemical Industries Ltd. of England is now available from J. B. Henriques Inc., 521 Fifth Ave., New York 17, N. Y. The material is designated Fluon CD1.

New Companies

Eclipse Plastic Machinery & Mfg. Corp. has been incorporated at Moline, Ill. to develop equipment and pilot initial operations for companies in the field of large blow molded items. Officers of the company include **E. G. Engman Sr.**, president; **William Getz**, and **Richard Hufford**, vice presidents. The first piece of equipment being introduced by the corporation is a two-stage blow molding machine reportedly of new design, capable of processing up to 3000 lb. of plastic material per hour. The (To page 216)

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machine is said to be capable of producing parts within a size range of 35 by 60 in., and weighing up to 60 lb. or more. An initial demonstration unit is installed in the Moline plant for research and pilot operations.

Midwestern Industries Corp., a new reinforced plastic boat manufacturing company, was formed by **Abner E. Crosby**. The new firm's manufacturing and warehouse facilities, totaling 15,000 sq. feet., are located at 5315 St. Joe Rd., Fort Wayne, Ind. Mr. Crosby was formerly head of Crosby Aeromarine Corp., which was purchased by Archer-Daniels-Midland Co. in 1958.

Metachem Resins Corp., 530 Wellington Ave., Cranston 10, R. I., is a new organization formed to supply specialized chemical formulations in the epoxy, polyester, and allied resins fields. **Herbert L. Spivack,** formerly technical director and general manager of Isochem Resins Corp., Providence, R. I., is president.

Expansion

The Borden Co. has acquired the business of the **Commercial Ink & Lacquer Co.,** Fair Lawn, N. J., and Whitehouse, Ohio, manufacturer of gravure and flexographic printing inks and varnishes used primarily by the packaging, laminating, and furniture finishing industries. The new unit will be formally known as the Ink & Lacquer Dept. of **The Borden Chemical Co.,** a Div. of The Borden Co. **George E. Jacques,** president, and **George B. Grupe,** vice-president, will remain active in day-to-day operations of the company. **James A. Wold,** former general manager of Borden's Consumer Products and Resinite Depts., was named general manager of the newly acquired unit.

Milprint Inc. has completed a $100,000 addition to its Milwaukee, Wis. plant which increases facilities for storage and handling printing inks. Automation methods are **(To page 218)**

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being installed to speed distribution of inks, lacquers, and coatings as well as to provide facilities for cleaning ink fountains, printing equipment, and laminating reservoirs.

The Texstar Corp., San Antonio, Texas, and **Air Accessories Inc.**, Fort Worth, Texas, merged. Air Accessories will continue operations at its present location under the new name **Texstar Plastics**, a division of The Texstar Corp. The branch factory operating at Fort Wayne, Ind. will continue under the direction of the Fort Worth based division.

Air Accessories is a leading manufacturer of formed acrylic windshields under the Del-Tex tradename. Other products include the firm's "floor show" transparent chair mat and related office accessories, and fibrous glass furniture, produced at the Fort Worth factory under the Sunlounger tradename.

The Texstar Corp., with assets in excess of $12 million, has worldwide interests, including holdings in oil and gas, as well as operating divisions in industrial, and construction fields. **W. I. Spitler**, president of Air Accessories, will be general manager of the division and a vice-president of the parent company.

The Rainville Co. Inc. is moving into new quarters at 839 Stewart Ave., Garden City, N. Y., with double the present office space. Adjoining the new offices will be a 1500-sq.-ft. demonstration bay for Blow-O-Matic blow molding machines, Bandera extruders, Foremost grinders, Rainkool refrigeration, and recirculating units and various other types of equipment. Operation of the demonstration bay and engineering department will be supervised by **Henry Thielfoldt**.

CTL Division of **Studebaker Packard Corp.** will build a new production plant at Santa Ana, Calif. to furnish high-temperature and structural plastic components for the western missile industry. Completion is scheduled

for June. CTL's administrative, research, and testing activities will remain at their present location in Cincinnati, Ohio.

Ethyl Corp. will build a plant for the manufacture of vinyl chloride monomer at its Houston, Texas manufacturing center. The new facility will supplement the company's vinyl chloride monomer plant at Baton Rouge, La. Completion is scheduled for the early part of 1961.

Vari-Plastics Inc. purchased the assets of custom molder **St. Clair Plastics**, Watervliet, N. Y. St. Clair Plastics continues operations in Kissimmee, Fla.

Nosco Plastics Inc., Erie, Pa., custom molder, has installed three new injection molding presses and has four more on order. The company also plans to double its facilities for mechanical decorating in 1960. The additions to the decorating department include screen painting equipment suitable for use on both flat and round pieces and will find additional use in Nosco's new blow molding department.

Radio Frequency Co. Inc., Medfield, Mass., broke ground for a 35,000-sq.-ft. addition to its plant. The new building will be used for research and development in induction and dielectric heating and ultrasonic applications.

Norton Laboratories Inc., Lockport, N. Y., has started installation of a battery of automatic presses. The first of these, a 75-ton automatic compression press, is now in operation. The new presses will augment the company's present facilities for compression and transfer molding.

Phillips Chemical Co., a wholly owned subsidiary of Phillips Petroleum Co., will substantially expand ethylene capacity by constructing a new plant adjacent to its existing ethylene plant at Sweeny, Texas. The new facility is in addition to an expansion program announced last fall. During April, 1960 production of the existing unit is expected to reach 290 million **(To page 220)**

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lb. of ethylene annually. The new plant, to be completed in the third quarter of 1961, will nearly double this capacity.

Celanese Corp. of America has acquired a modern 84,000-sq.-ft. one-story building in Clark Township, N. J. as the site of a new plastics development laboratory. Research into new plastics will continue at the Celanese Central Research Laboratories, Summit, N. J. About 120 employees are currently engaged in technical service and product application work at the new facility.

Reichhold Chemicals Inc. plans to acquire the assets of **Alsynite Co. of America,** subject to the approval of Alsynite stockholders. Included will be the Alsynite Co.'s assets and business in the **Alsynite Co. of California, Alsynite Co. of Ohio, Alsynite Co. of New Jersey, Everlite Corp., Plastikool Awning Corp., Ray-O-Lite Corp. of America,** and **Chemiglas Inc.** Alsynite engaged primarily in manufacturing and selling reinforced plastic panels.

The Brunswick-Balke-Collender Co., Chicago, Ill., has acquired **Owens Yacht Co. Inc.,** Baltimore, Md. Following the merger, Owens will be operated as a division of Brunswick under Owens present management. Owens has been in the field for 25 years, and is believed to be the second largest producer of pleasure boats. The company's fibrous glass boat sales have grown substantially; in 1959 they accounted for approximately one-third of total sales of $15,-430,000, and are currently about 40% of volume.

Extrudo-Film Corp., Long Island City, N. Y., has acquired **Alfred Charles & Co.,** Milford, Conn., extruders of cast polyethylene and polypropylene films. The machinery is being relocated to Extrudo-Film's Pottsville, Pa. plant. Alfred Charles personnel is being retained, and **Charles Strange,** formerly president, has joined EFC, to head research and development; **(To page 222)**

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this acquisition enables EFC to offer crystal clear cast PE film in widths to 72 in. as well as new packaging films, such as polypropylene, linear polyethylene, and nylon.

Continental Can Co. is following up the creation of its Plastic Bottle and Tube Div. by establishing plastics bottle production facilities in Los Angeles, Calif., Baltimore, Md., and Cincinnati, Ohio, to supplement the production offered by its present Chicago, Ill. plant. All of the new production lines will make custom molded bottles in sizes up to and including 32-ounce. The new facilities are nearing completion.

Tel-A-Sign Inc., manufacturer of illuminated plastic signs, has doubled the size of its manufacturing-warehousing facilities and moved into new quarters at 3401 W. 47th St., Chicago, Ill.

H. B. Fuller Co., St. Paul, Minn. manufacturer of adhesives, with 14 plants in the United States and Canada, is adding 7000 sq. ft. to its Linden, N. J. branch. The $75,000 construction project will be completed by early summer.

Naugatuck Chemical Div., U. S. Rubber Co., will construct a new technical center near its main plant in Naugatuck, Conn. to broaden research for new products and speed technical service for customers of the division's expanding lines of plastics, chemicals, and rubbers. Construction will begin in mid-1960 and completion is scheduled for 1961. The center will be staffed with about 100 scientists and technicians from the division's research and development department. Window glazing made from glass-reinforced Vibrin polyester resin will be used across the entire front of the building in modern curtain wall type of construction. Tropicel decorative translucent paneling will be used for some interior partitioning. Vinyl upholstery will be used for lobby and office seating. Naugawall, a new type **(To page 225)**

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of vinyl wall covering, will be used in many areas as will the new vinyl-metal laminates produced by the division's Marvibond process. Vinyl floor tile will be the major floor covering. Piping made from Kralastic, a rubber-plastic blend, will be used in many of the laboratories, and brick glazed with a Vibrin polyester coating will form the walls in the locker rooms.

American Cyanamid Co. plans to construct a plant to manufacture melamine in England adjacent to Cyanamid's present pharmaceutical plant at Gosport. The new unit will be operated by **Cyanamid of Great Britain Ltd.,** a wholly-owned subsidiary. The 3,000-sq.-ft. building will have a capacity of 6 million lb. of melamine a year, and is scheduled for completion by early next year.

General Electric Co., Chemical Materials Dept., expects to have its self-contained polycarbonate resin manufacturing plant near Mount Vernon, Ind., in operation in the third quarter of 1960. This multimillion-dollar, multimillion-lb./yr., commercial plant for Lexan resins represents a further scale-up of semi-works and pilot plant facilities that have operated since early 1957 at Pittsfield, Mass. The Indiana installation will meet the growing demand for polycarbonates, while the Mass. unit will further development work in this new field of premium-property plastics.

The Dow Chemical Co. has embarked on a $30 million expansion program at its **Louisiana Div.,** Plaquemine, La. The program includes increases in production facilities for vinyl chloride, chlorine and caustic soda, and construction of a plant to produce anhydrous and aqueous ammonia. The expansion program is expected to extend over the next two years.

Dow Chimica Italiana S.p.A., a newly-formed wholly-owned subsidiary, plans to construct a multimillion dollar plant in Italy. Products are being **(To page 226)**

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considered for manufacture, one of which is the entire line of Styron polystyrene plastics. Marketing offices have already been opened in Milan.

Horkey-Moore Associates, Torrance, Calif., engineering organization for the production of aircraft and missile components, has formed a plastics division. The new unit will be devoted to the application and extension of reinforced plastics technology to missiles, aircraft, and space vehicles, as well as commercial and industrial products. The division will undertake the fabrication of RP structures capable of withstanding very high temperatures. **Carl S. Seybold,** formerly with Du Pont and North American Aviation, joined as manager of the new division. **Vincent G. Gurley** is assistant manager. Employment for the division is scheduled to reach 100 by the end of the year.

Photocircuits Corp., Anaheim, Calif., is constructing a $500,000 fully integrated manufacturing facility for printed circuits.

The Glidden Co., Chemicals Div., opened a new inorganic research and development center in Baltimore, Md. Included in research projects at the new facility are studies on cadmium red and yellow pigments for plastics.

Tronomatic Machine Mfg. Corp., package and plastic forming machinery manufacturer, has moved its manufacturing facilities and offices from 1881 Park Ave. to a new, larger plant at 25 Bruckner Blvd., Bronx, N. Y. The increased plant space will accommodate production of new equipment including sheet forming and expandable styrene foam molding machines and accessories.

Standard Cap & Molding Co., Baltimore, Md., has entered the injection molding field in the Middle West at its new plant in Hillside, Ill. Four automatic Lester-Phoenix presses, ranging in sizes from 2 to **(To page 228)**

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8 oz., have been installed. **Chester Kotecki**, formerly plant manager for Plastic Molded Products Co., Chicago, Ill., will supervise the new facility. **Walter Frank Organization**, Chicago, Ill., represents Standard Cap & Molding in the Middle West.

Meetings

Plastics groups

April 25, 26: Society of the Plastics Industry Inc. (SPI) 18th Annual Canadian Section Conference, London Hotel, London, Ont., Canada.

April 26: Society of Plastics Engineers Inc. (SPE) Eastern New England Section and Lowell Technological Institute student chapter. Dr. Herman F. Mark, "Polymers of the 60's," Lowell Technological Institute, Lowell, Mass.

May 11-13: SPI Thermoplastics Pipe Div. meeting, Americana Hotel, Bal Harbour, Fla.

May 12, 13: SPI National Plastics Molder & Suppliers Conference, Americana Hotel, Bal Harbour, Fla.

May 17: SPE Newark Section, Dr. E. B. Bagley, "A visual study of the flow of molten polyethylene in a die," Celanese Corp. Auditorium, Summit, N.J.

May 20, 21: Norwegian Plastics Federation (Norsk Plastforening) International Plastics Exhibition and Convention, Oslo, Norway.

Other groups

April 25, 26: American Institute of Electrical Engineers, 12th Annual Technical Conference on Rubber & Plastics Industries, Sheraton Hotel, Akron, Ohio.

May 23-26: The American Society of Mechanical Engineers (ASME) Design Engineering Conference & Show, Statler Hilton Hotel, New York, N.Y.

June 9-11: Manufacturing Chemists' Assn. Inc. (MCA) 88th Annual Meeting, The Greenbrier Hotel, White Sulphur Springs, W. Va.—**End**

COMPANIES...PEOPLE

Appointments, promotions, and relocations in the plastics industry.

Spencer Chemical Co.: Rae Stirrat, formerly mgr. of the company's sales service laboratory and field tech. service activities, assigned to head the marketing activities involving the Engel process. **Lynn Duncan** has been promoted from mgr.—market development to succeed Mr. Stirrat. **William Claypoole** promoted from product mgr.—polypropylene to mgr.—market development. **L. R. Gentile,** formerly a market development rep., assumes Mr. Claypoole's previous position. **Frank Packheiser** promoted from sr. tech. service rep. to mgr. of the company's nylon tech. laboratory, a part of Spencer's nylon-6 production plant at Henderson, Ky.

B. F. Goodrich Chemical Co.: George A. Mentzer named mgr. of trade advertising and sales promotion, succeeding **George B. Koch,** who recently advanced to a managerial post in the new corporate advertising group at BFG. **Philip H. Lawrence,** plant mgr. at Niagara Falls, N. Y., will assume the same position at the vinyl resin and compound plant near Long Beach, Calif.

Mobay Chemical Co. moved its headquarters from 1815 Washington Rd. to Penn Lincoln Parkway West, Pittsburgh 5, Pa. **Ronald P. Marsh,** previously with the plastics sales service laboratory of Phillips Chemical Co., joined as tech. service rep. for Merlon polycarbonate resins.

Food Machinery & Chemical Corp.: Donald C. Oskin named v-p of exec. sales of the five chemical divs., which includes the Chemicals & Plastics Div. He was formerly v-p and asst. mgr. of FMC's Inorganic Chemicals Dept.

Chemicals & Plastics Div.: George H. Knox appointed Midwest dist. mgr. for Dapon diallyl phthalate resin. He will have headquarters at 6 N. Michigan Ave., Chicago 2, Ill.

The Dobeckmun Co., div. of The Dow Chemical Co.: John T. Hastings named asst. to the mgr.—industrial sales div. The following new sales reps. were assigned to branch offices: **Edward C. Holt,** Cincinnati, Ohio; **Paul T. Beutel,** Charlotte, N. C.; **James W. Fraylick,** Boston, Mass.; **Louis F. Vasel,** St. Louis, Mo.; **Lewis Williams Jr.,** Baltimore, Md.; **Walter W. Shaffer** and **Walter R. Dickhaut,** New York, N. Y.; and **Gordon G. Lee,** Cleveland, Ohio.

Nopco Chemical Co., Plastics Div.: Benjamin S. Collins promoted from mgr.—system sales to div. gen. mgr. at North Arlington, N. J. He is succeeded by **Robert E. Weber,** who is now responsible for national sales of Lockfoam poured-in-place urethane foam. **John N. Gulick** appointed gen. sales mgr. He is succeeded as mgr.—flexible foam sales by **Richard A. Singer,** previously asst. sales mgr.

Structural Fibers Inc., Chardon, Ohio: **Arthur J. Wiltshire,** formerly chief engineer, Apex Reinforced Plastics Div. of White Sewing Machine Co., joined as chief project engineer. He has been chrmn. of the S.P.I. Preform and Mat Die molding committee since its inception 10 years ago, is a member of the S.P.I. Policy and executive committees, Reinforced Plastics Div., and a winner of the div.'s service award.

A. Wiltshire

Robert Gelin named asst. to **Thomas Harris,** v-p. He will be responsible for design and production methods for company products, including plastics parts and assemblies reinforced with fibrous glass, synthetic and natural fibers.

Society of Plastics Engineers Inc. formed a Florida Section with headquarters at 4000 N. W. 29th St., Miami 42. The section will meet the third Monday of each month at Jerry's Restaurant. **Paul Landers** is pres. of the Section.

Vinyl Professional Activity Group: Sol Gobstein, Ferro Chemical Co., succeeded **Robert Abeles, Elfskin Corp.,** as chrmn. for 1960. **Joseph B. Clancey, Emery Industries,** elected 1st v-chrmn.; **Irvin Podell, Podell Inc.,** 2nd v-chrmn.; and **Walter Waychoff, Monsanto Chemical Co.,** secy.

Allied Chemical Corp.—Plastics & Coal Chemicals Div.: H. Clay Warmouth, formerly div. sales rep. in Cincinnati, Ohio, named Western sales rep. with offices in Los Angeles, Calif. He succeeds **Edward M. Lemon,** recently appointed asst. mgr., chemical sales.

National Aniline Div.: Dr. B. G. Firstenberger appointed asst. to the plant mgr., Moundsville, W. Va. **Paul L. Oertel** named mgr. of advertising and **James P. Foley,** mgr. of publicity at the New York offices.

Monsanto Chemical Co.—Plastics Div.: Edward H. Myers appointed asst. product mgr., polyethylene resins, at Springfield, Mass. **Donald R. Mahaney** succeeds Mr. Myers as market specialist for packaging in the market development dept. Drs. **Jose V. Aleman, George J. Anderson,** and **David C. Chappelear** joined the research dept. **Richard J. Hartl** joined the production tech. service dept., and **Charles A. Pratte Jr.,** the plant engineering dept.

Plastics Div. at Texas City, Texas: **J. S. Putnam,** formerly plant mgr., joined the staff of the asst. gen. mgr. He is succeeded by **J. M. Chamberlin,** former asst. dir. of engineering. **R. W. Kienker,** previously mgr. of the development engineering group, promoted to Mr. Chamberlin's former post. **W. J. Burkett, E. John Mackie,** and **Clyde T. Massey** named sr. engineering supvs. **Clyde W. Braswell** appointed engineering specialist, and **M. A. Vela** an engineering supv. **Dr. Dennis E. Wade** joined the research dept., **Miloslav J. Chaloupka,** the tech. service dept., and **William E. Lynch Jr.,** the maintenance dept.

Synthane Corp., Oaks, Pa., opened fabricating and warehouse facilities for its industrial laminated plastics at 518 Garfield Ave., Glendale, Calif. **Bert C. Kibre,** former Los Angeles, Calif, area rep., was named mgr. of the West Coast operation and will have his office at the new location. **Lynn N. Cook** is sales rep., and **Morris Phinney** joined the Western Pa. sales staff.

Union Carbide Plastics Co., Div. of Union Carbide Corp.: C. S. Shoemaker, tech. sales rep. in the South Atlantic region, is now located at the new sales office in the Guildford Bldg., Greensboro, N.C. **Robert Halvorsen,** now a tech sales rep. at the Dallas, Texas office; **David M. Fix** assigned as tech. sales rep. to the Moorestown, N. J. office; and **G. J. Weis** transferred as tech. sales rep. from Moorestown to Atlanta, Ga.

Reichhold Chemicals Inc., Varcum Chemical Div.: O. Jay Myers appointed acting gen. mgr. in addition to his duties as v-p in charge of RCI's Foundry & Abrasive Products Div. **George Lewis,** pres. of the Div., retired. **Dr. Roland McDonald** named divisional v-p. **Donald Keenan** appointed v-p in charge of production for the Div. He held this position with Varcum Chemical Corp. prior to its purchase by RCI. **John Cummings** is sales mgr. The Div. manufactures a wide range of liquid, powdered and solid phenol-formaldehyde resins.

Alsynite Co. of America: Seymour R. Fishman named branch mgr. of the company's Paterson, N. J. plant. **Robert Hawkins,** formerly asst. gen. sales mgr. at San Diego, Calif., appointed dist. sales mgr.—Middle Atlantic **(To page 232)**

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states, with headquarters at Paterson. He will be assisted by **Richard E. Franck.** Alsynite manufactures translucent RP panels.

Formica Corp., Cincinnati, Ohio: **James L. Grant** assigned to the Minneapolis, Minn. office, **John A. Meskill**, to the Indianapolis, Ind. office, and **George F. Yeager**, to the Atlanta, Ga. office as sales reps. for Formica decorative products.

The Emeloid Co., Hillside, N. J.: **W. C. Lowney** elected an exec. v-p, and **W. D. Leeds** elected a v-p. The company is a manufacturer of thermoplastic components and advertising specialties.

Taylor Fibre Co., Norristown, Pa.: **Joseph A. Morris** named asst. sales mgr. He was formerly sales service mgr. of the company. **Fred Jaeschke**, formerly sales service rep., appointed sales engineer in the Md., Va., and Washington, D. C. territories. He is replaced by **Edward Brewer. Gordon Platt** reassigned from the company's Hartford, Conn. branch office to the Philadelphia, Pa. sales territory.

D. H. Litter Co. Inc., New York, N. Y.: **Harold L. Davis** named exec. v-p and gen. mgr., **Frank E. Bolway Jr.** is v-p and sales mgr., **Sidney B. Levinson** appointed v-p and tech. dir., and **Morris Coffino** is now tech. service mgr. The company is manufacturer rep. for **Godfrey L. Cabot Inc.; Ciba Products Corp.; Davison Chemical Co.,** Div. of **W. R. Grace & Co.; Marbon Chemical Div., Borg-Warner Corp.; Nuodex Products Co.,** Div. of **Heyden Newport Chemical Corp.; Union Carbide Plastics Co.;** and others in the N. Y. and New England areas.

Injection Molding Co., subsidiary of **Rexall Drug & Chemical Co.: E. M. Davis** promoted from dir. of purchasing to v-p concerned with production aspects in Imco's subsidiary plants in the U. S. and Canada. **Frederick L. Kocher**, formerly dist. sales mgr. in the Chicago, Ill. area, now gen. sales mgr.

Haveg Industries Inc., Taunton Div., Taunton, Mass., made the following managerial appointments: **Emil J. Kleiner**—injection molding operation; **George S. Irby**—engineering; **Everett L. Stewart**—materials; and **Frank Slavin**—marketing development manager.

Acme Backing Corp. moved its **Industrial Products Div.** from the mill in St. Louis, Mo., to the gen. offices of Acme in Stamford, Conn. Coated and laminated fabrics now made in St. Louis will continue to be made there. Sales **(To page 234)**

"Please recommend a material which will . . . "

"Our need is a plastic wheel that . . . "

"Do you know of a manufacturer who . . . ?"

" . . . and how can we insulate it?"

"Who makes stock molded cookie cutters?"

"Where can I purchase a machine that . . . ?"

Each month the Readers' Service Department of Modern Plastics answers scores of questions for our readers. Questions range from simple requests for information about the manufacturer of a stock molded item to requests which must be referred to industry sources for action.

With their extensive files, reference library and wide knowledge of plastics materials, machinery and procedure, the members of the Readers' Service Department can usually supply, or refer you to someone who can supply, the information you want.

If you have a question, feel free to forward it. There is no charge or obligation for this service. Address—Readers' Service Department, Modern Plastics. A complete reply to your inquiry will be sent promptly.

MODERN PLASTICS

A Breskin Publication

575 Madison Avenue New York 22, N. Y.

COMPANIES...PEOPLE

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activities will henceforth be carried on from Stamford where **Lee R. Jacobs**, mgr., will headquarter.

The Ceilcote Co., Cleveland, Ohio, formed a Process Equipment Dept. to develop and market a complete line of standard as well as custom reinforced plastic products for processing highly corrosive fumes and fluids. **Stanton V. Sheppard,** formerly chief of Ashland Oil & Refining, has been appointed mgr. of the new div.

Firestone Plastics Co., Chemicals Div.: Lee B. Kuhn promoted from sales mgr. to v-p replacing **Frank J. Groten** who retired. Mr. Kuhn is succeeded by **Jay H. Rosenson. T. C. Walker** appointed mgr., sales development, latex products; and **J. E. Sloat**, mgr., electrical materials.

Wyrough & Loser, 2 Brunswick Circle Extension, Trenton, N. J., opened a branch office at 1388 Dixwell Ave., New Haven, Conn. headed by **Carl A. (Whitey) Larson.** The company represents a number of chemical companies supplying products for plastics compounding.

Wheelco Instrument Div. of Barber-Colman Co., Rockford, Ill., mfr. and distributor of instrumentation for plastics processing, opened a regional sales and service office at 750 Monterey Pass Rd., Monterey Park, Los Angeles, Calif. **W. F. Paetz** promoted from branch sales mgr. to regional sales mgr.

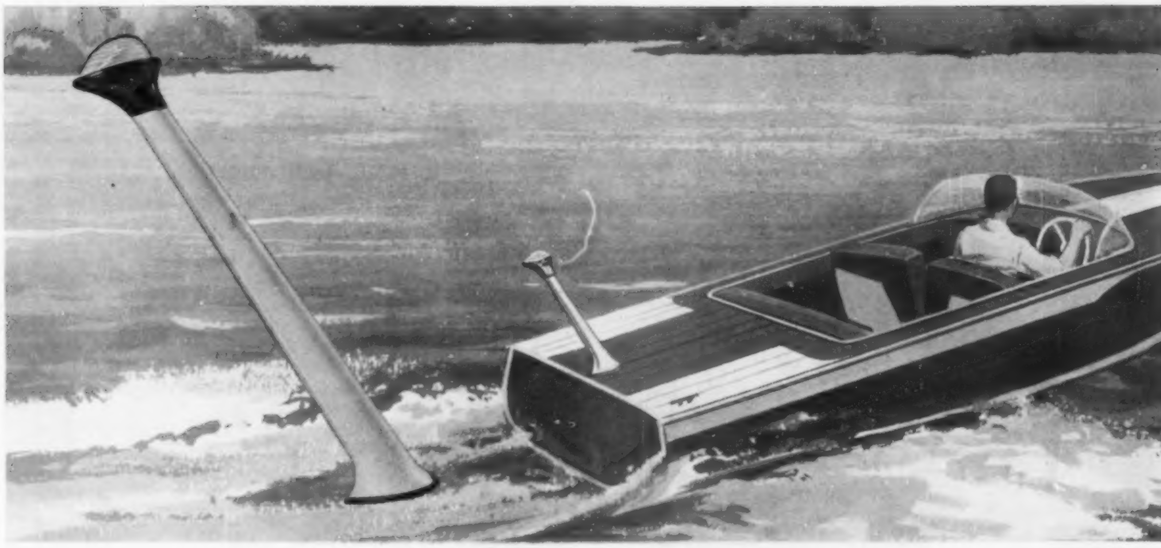
Harwick Standard Chemical Co., Akron, Ohio: **Henry J. Sullivan** named tech. sales rep. at the Boston, Mass. office. **G. Robert Moore** assigned to head the San Francisco Bay, Calif. area.

Ryko Products Inc. and **Ryko Mfg. Inc.,** Los Angeles, Calif.: **Howard W. Vipperman,** v-p of Ryko Products, named gen. mgr. for both corporations. **Roy W. Ryden Jr.** appointed v-p in charge of R & D of Ryko Mfg. **Donald Sisson** named chief engineer and **Max Antritter,** plant mgr. of Ryko Products. Ryko Products is an extruder and fabricator of plastics.

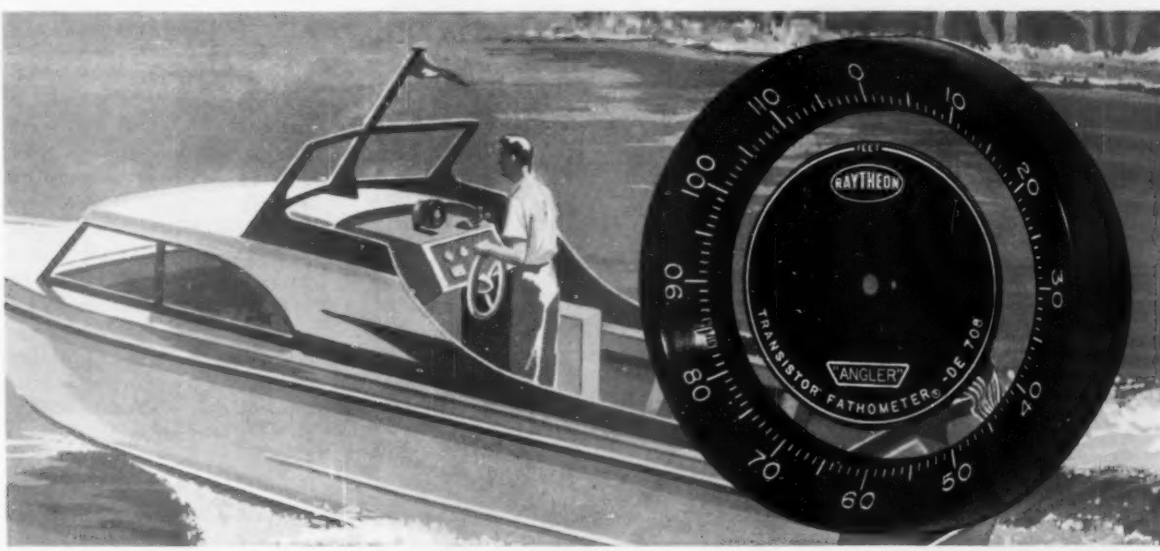
Acheson Dispersed Pigments Co. moved from 14421 Chestnut St., to Suburban Station Bldg., 1617 Pennsylvania Blvd., Philadelphia 3, Pa.

William L. O'Neill named mgr. of the newly formed architectural div. of **Fibre Glass Evercoat Corp. of Florida,** Miami, Fla. The div. markets polyester, epoxy, and polysulfide polymer compounds.

Dr. Saul M. Cohen appointed a group leader in **Shawinigan Resins Corp.** research dept., **(To page 237)**



Handsome and Hardworking
Plexiglas...Implex



Look how PLEXIGLAS® acrylic plastic and IMPLEX®, the high impact acrylic, work together! PLEXIGLAS for the stern light lens shown above and the dial section of the depth finder, below. IMPLEX for the staff of the stern light and the housing of the depth finder.

One or both of these two Rohm & Haas molding materials —strong, handsome PLEXIGLAS and tough, colorful IMPLEX—may be just what you need to give *your* products added usefulness and sales appeal. We will be glad to send you detailed information, and provide design assistance to help you take full advantage of the outstanding properties of PLEXIGLAS and IMPLEX.

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

In Canada: *Rohm & Haas Company of Canada, Ltd., West Hill, Ontario*

TOPS FOR CAPS

. . . SUPER DYLAN® high-density polyethylene

These aerosol can caps for two well-known products are molded by Gilbert Plastics from SUPER DYLAN high-density polyethylene. This tough, strong plastic is durable, will not chip or dent. The unique cap design protects the spray nozzle and makes the cans easy to stack, saving valuable counter display space.

SUPER DYLAN is dimensionally stable, light in weight, rustproof, and chemically inert. It has a smooth, glossy finish and can be molded in any color desired. Its ease of molding makes it possible to create caps for any size or shape of can.

SUPER DYLAN is "tops" as a packaging material. It can be molded into bottles and jars for liquids and semi-solids—in colorful, decorative and utilitarian closures for cosmetics and pharmaceuticals—or extruded as boilable, freezable SUPER DYLAN film for food packaging. For more information, write to Koppers Company, Inc., Plastics Division, Dept. MP-4, Pittsburgh 19, Pennsylvania. Offices in Principal Cities, In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario.

KOPPERS PLASTICS

KOPPERS®

Molder: Gilbert Plastics, Inc., Kenilworth, N. J.

(From page 234)

Springfield, Mass. He will organize a research group which will be responsible for exploratory research in the synthesis of new plastic resins.

Howard Shannon, pres. of **Supplex Co.**, also named pres. of **American Hard Rubber Co.** Both companies are divisions of **Amerace Corp.** He succeeds **Newton H. Tuthill**, who resigned. American Hard Rubber Co. manufactures plastics and rubber industrial and consumer products.

A. F. Thomas appointed to the newly created position of sales mgr. for **The Goodyear Tire & Rubber Co., Films & Flooring Div.** He assumes sales responsibility for all division products, which include flooring, packaging films, and plastic films and sheeting. Mgr. of division field sales since 1957, Mr. Thomas joined the Goodyear organization in 1942 as a member of the production control dept. at the Akron, Ohio subsidiary, **Goodyear Aircraft Corp.**

A. F. Thomas

George L. Smead elected v-p sales, **Midwestern Industries Corp.**, Fort Wayne, Ind. mfr. of fibrous glass boats. He was formerly staff mgr. for RP in the textile section of Johns-Manville Fiber Glass Div.

Ben Winston joined the Eastern div. sales staff of **Tri-Point Plastics Inc.**, Albertson, N. Y. supplier of Teflon extrusions and precision parts.

George A. Stryker joined **Extrudo-Film Corp.**, Long Island City, N. Y., as Southeastern rep. working out of Jacksonville Beach, Fla.

William A. Kelley, former tech. service rep. with Monsanto Chemical Co. plastics div., joined **Frank W. Egan & Co.** as a sales engineer in the plastics div.

Max Klueger named Eastern sales engineer of **National Rubber Machinery Co.** His office will be located at 384 Getty Ave., Clifton, N. J.

Allyn E. Webb appointed sales mgr. of **Chemtrol**, mfr. of plastic valves and related equipment.

Edwin S. Elgin, v-p—Plastics Div., **Chase Bag Co.**, New York, N. Y., elected pres. of the **National Flexible Packaging Association.**

Raymond H. Marks, formerly v-p in charge of sales for **Cary Chemicals Inc.**, New Brunswick, N. J., appointed exec. v-p. His new duties will include the (To page 238)

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coordination of all mfg., research and sales activities, for the company's PVC resins and compounds.

Donald Moritz joined **Stauffer Chemical Co.** as asst. dir. of sales, Molded Products Div., Los Angeles.

Dr. Charles H. McBurney appointed dir. of research of **Rohm & Haas Co.,** Philadelphia, Pa. He succeeds **Dr. Ralph Connor,** who continues as v-p in charge of research and chrmn. of the board.

Robert F. Scalise named dist. sales mgr. of the **Warren Parts Div., Sylvania Electric Products Inc.,** a subsidiary of **General Telephone & Electronics Corp.** The div. is a supplier of custom molded plastics and components and assemblies.

Chet Haley appointed sales mgr. of **Bradley Associates Inc.,** Chicago, Ill. mfr. of plastic boxes and custom molded containers.

Carl W. Virgin named marketing coordinator-plastics for the **Enjay Co. Inc.,** New York, N. Y.

John Balazs named v-p of **Romar Plastics Inc.,** St. Charles, Ill. injection and compression molders.

Dennis Lietz joined **Colton Chemical Co.,** a div, of **Air Reduction Co. Inc.,** Cleveland, Ohio, as a research chemist in the polymer section.

Kenneth L. Sayre joined **Bjorksten Research Laboratories,** Madison, Wis., as sr. project leader in the Organic & Plastics Div.

Donald M. Hatch Jr. elected a v-p of **Dumont Mfg. Corp.** and its parent firm, **Dutron Corp.,** both of San Rafael, Calif. Among other administrative duties, he will be a gen. mgr. in charge of sales, production, and research work on Dumont's line of reinforced plastics products.

James C. Denney appointed mgr., commercial service, with **Pribble Plastics Products Inc.,** New Haven, Ind. custom molders of thermosetting plastics materials.

John F. Ortner named product mgr., molding compounds, in the sales dept. of **Durez Plastics Div., Hooker Chemical Corp.,** N. Tonawanda, N. Y. Asst. product mgr., molding compounds, since 1955, he succeeds **Frank C. Rowley,** who died recently.

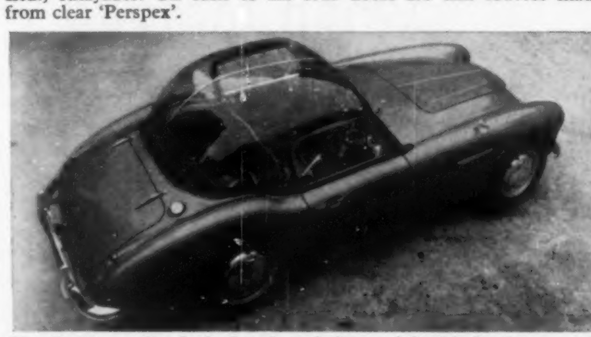
Charles F. Peterson joined **Dewey & Almy Chemical Div., W. R. Grace & Co.,** as mgr. of organic chemicals, Western div. He will make his headquarters in Los Angeles, Calif., and will be in charge (To page 241)

Sunbeam Alpine made by Rootes Group Ltd., Coventry, showing wrap-round, rear window made from 'Perspex' acrylic sheet, by P.D.I. Limited, Birmingham.

More and more 'Perspex' is being used in modern cars

IN modern cars great use is being made of 'Perspex' acrylic sheet—are you making full use of this truly outstanding material ? 'Perspex' offers excellent clarity in clear form as well as an extremely high degree of light transmission in tinted form. It is light in weight and can be formed to smooth, modern, streamlined shapes. Another great advantage 'Perspex' offers is toughness. It has long been established that 'Perspex' stands up to weather conditions throughout the world. Finally, 'Perspex' is a handsome, longlasting material, a material modern car owners are glad to have in their cars.

3-litre Rover made by The Rover Co. Ltd., Solihull, showing sun visors made from coloured 'Perspex' acrylic sheet by E. F. Tanner & Co. Ltd., Rhayader. On each of the four doors are side louvres made from clear 'Perspex'.



The Pexidome Co. Ltd., London, design and fit this hard top, made from 'Perspex' acrylic sheet, to Austin Healey cars.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

ICI

U.S.A. enquiries to: J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to: Canadian Industries Ltd., Plastics Division, Box 10, Montreal P.Q.

P758/O/A


dial

(From page 238)

of sales of vinyl acetate polymers and copolymers, butadiene styrene latices, plasticizers, etc.

Robert Shevett named tech. sales dir. of **Rainville Co. Inc.**, Garden City, N. Y. suppliers of equipment.

Henry C. Guhl elected v-p for engineering of the **National Vulcanized Fibre Co.**, Wilmington, Del.

Ralph E. Eckerstrom appointed dir. of advertising and public relations for **Container Corp. of America**, Chicago, Ill., in addition to his current position as dir. of the company's dept. of design.

Dr. Robert H. Barth appointed mgr. of research responsible for the operation of **Heyden Newport Chemical Corp.'s** Garfield, N. J. laboratories. He is a research authority on the chemistry of pentaerythritols.

Harold J. LeBeck named asst. mgr. of the industrial plastics and bearings div. of **Joseph T. Ryerson & Son Inc.**, Chicago, Ill. distributor and fabricator of plastics.

John Gillette named gen. mgr. of the new Atlanta, Ga. offices and warehouse of **Commercial Plastics & Supply Corp.**, New York, N. Y. The Atlanta office will stock a complete line of sheet, rod, tube, and film.

Robert J. Fulop appointed mgr. of the newly formed Market Research Div. of **Consolidated Paper Co.**, Monroe, Mich. The company recently introduced a phenolic-impregnated kraft board for low cost forming of industrial and consumer products.

Frank Connell, previously with W. R. Grace & Co., joined the polyethylene container engineering staff of **Delaware Barrel & Drum Co.**, Wilmington, Del.

Donald H. Denholm, formerly with Chase Bag Co., appointed exec v-p of **Ames Bag & Packaging Corp.**, Selma, Ala. producer of transparent films, bags, injection molded plastics, fabricated and formed acetate containers, blister and skin packages, and expandable styrene products.

Harry E. Gower appointed sales mgr. of **Radio Frequency Co. Inc.**, Medfield, Mass. supplier of high frequency induction and dielectric generators for the plastics industry.

Norman J. LeCompte appointed sales mgr. of waterproof protective clothing at **U. S. Rubber Co.** He succeeds **Virgil A. Wibbelsman**, who retired. Products under Mr. LeCompte's sales direction include plastic coats and jackets, **(To page 242)**

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sports clothing, and industrial clothing. He will make his headquarters in U. S. Rubber's Washington, Ind. plant, where all the company's waterproof clothing is made.

New reps.

Plastic Sales & Mfg. Co., Kansas City, Mo., named distributor for thermoplastic sheet and film manufactured by **Campco**, a div. of **Chicago Molded Products Corp.** Plastic Sales will distribute Campco S-540 rubber modified styrene, B-120 butyrate, PE-200 linear polyethylene, and A-130 cellulose acetate, and will also accept custom orders on these and other Campco materials . . .

Irving Paeff, 14901 N.E. Seventh Ct., North Miami, Fla., appointed Southern rep. for **Schwartz Chemical Co. Inc.**, 50-01 Second St., Long Island City 1, N. Y., for its line of plastic and rubber base adhesives . . . **John G. Shelley Co. of Conn. Inc.** appointed exclusive Conn. rep. for **Precision Molding Inc.** with **William Y. W. Magruder** and **George W. Crouse III** providing engineering and design assistance in the fields of specialized molding . . .

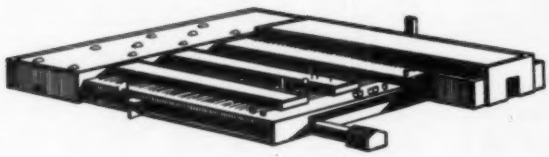
Gillespie & Gorman Sales Co., 32 Rittenhouse Pl., Ardmore, Pa., named sales rep. for Durathene polyethylene film, a product of the Plastics Div., **Koppers Co. Inc.** . . . **Industrial Plastics & Chemicals**, Oakland, Calif., appointed distributor by **Hastings Plastics Inc. James F. Rae** will direct distribution in the northern Calif. area of the complete line of Hastings products, including epoxy polyester, phenolic and other resin formulations and plastic shop supply items . . .

Westinghouse Electric Corp. has appointed two new distributors for industrial Micarta laminates: **Earl B. Beach Co.**, Pittsburgh, Pa., and **William F. McGraw & Co.**, Detroit, Mich. . . . **Allied-Erie Distributors Inc.**, Erie, Pa., named as a distributor for **Formica Corp.**, subsidiary of **American Cyanamid Co.**, to handle building products in Erie, Crawford, and Warren Counties, Pa., and Chautauqua County, N. Y. . . .

West Coast Plastics Distributors Inc., 9014 Lindblade St., Culver City, Calif., appointed distributors in the 11 Western states for **Price-Driscoll Corp.**, Rockville Center, N. Y. supplier of Super King Bomb-Lube, a self-dispensing aerosol mold release.

Correction

"Reinforced plastics . . . how they have done, where they are headed" (MPl, Feb. 1960, p. 87): Housing for the drill grinder produced by the Cimastra method of slurry preforming was developed by Cincinnati Milling Machine Co.—**End**



CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment for sale

FOR SALE: Ovens, Grinders, Powder Mixers, Injection Molding Machine 1 oz. to 60 ozs. never used and used. Two-head Bottle Blowing Machine. Acme Machinery & Mfg. Co. Inc., 20 South Broadway Yonkers, N.Y. YOnkers 5-0900. 102 Grove Street, Worcester, Mass. PLeasant 7-7747.

400 TON, 18" ram stroke, 52" vertical opening x 22" R to L Lehmann Press—75 ton 14" x 14" Stewart-Bolling Press—150 ton 13" x 14" Southwark Press—30 ton 8" x 8" Burroughs Press—Carver Laboratory Presses and others to 75 ton—¾" Double Solenoid 3000 psi four way and ¾" 3000 psi Cam operated hydraulic valves. PLASTIC MACHINERY EXCHANGE, 426 Essex Avenue, Boonton, N. J. telephone DEerfield 4-1615.

FOR SALE: All Electric Hydraulic Plastic Laminating Machine. Size 10" x 12"—4 Plate Capacity with Extras. French Stenk Co., 1285 Main St., Swoyerville, Pa.

FOR SALE: Stainless reactors or resin Kettles: 3500, 2200, 1900, 1300, 1000, 750, 500, 350 gal. jktd. and agit. Baker-Perkins dbl. arm mixers: 200, 100, 50 gal. capacity, steel or stainless. Perry Equipment Corp., 1429 N. 6th, Phila. 22, Pa.

FOR SALE: 250 ton Bliss Hydrodynamic press 80" daylight, 30 x 30 ram area. 125 HP, 2300 motor, mfg. 1940, $7950, f.o.b. Framingham, Mass. Reply Box 6484, Modern Plastics.

CHECK THESE SPECIALS: 2 oz. Watson-Stillman Vertical Injection Molding Machine. Completely self-contained with all operating and heat controls. 60 oz. HPM Injection Molding Machine, late type, inspect on location. Complete with all controls equipped with exact weight feed and mold coolers. 300 Ton Stokes Transfer Molding Press, model 250-A with dual Vickers Hydraulic Pumping System. 75 Ton Baldwin-Southwark Transfer Molding Press, completely self-contained with all operating controls. Stokes Model "F" and Colton Model 4½ "T", single punch Tablet Presses. Individually motor driven. NRM 1½" Electrically Heated Plastic Extruder. Complete with wheelco panel board and Vari-speed drive. 600 Ton Adamson Multi-opening Hydraulic Press. 26" Diameter chrome-plated ram, slab side construction. Press contains nine 42" x 42" platens. New 1951. Also in stock: Watson-Stillman 12 oz. Injection Molding Machine, Van Dorn 1 oz. lever-operated Injection Molding Machine, 2 oz. Van Dorn semi-automatic Injection Molding Machine, new 1955, NRM 2½", Royle 3¼", Hartig 3¼" and Adamson 6" Extruders. Also a complete line of Blenders, Mixers, Scrap Cutters, etc., for the Plastic and Rubber Industries. WHAT DO YOU NEED? WHAT DO YOU WANT? We Will Finance. JOHNSON MACHINERY COMPANY, 683 Frelinghuysen Avenue, Newark 12, New Jersey, BIgelow 8-2500.

POWDER BLENDERS: 10,000 lbs. Lab. Mill 6 x 16. 1 Farrel 16 x 36 Mill 30 HP motor & drive. Baker Perkins 150 gal. 2 arm, 40 HP; 100 gal. 2 arm, 50 HP, S. S. jacketed, vacuum, hydr tilt. Stokes 3 DDS2, 1 S, 1 T 6 R's. Calendar 6 Roll 5" x 12". 1 S. S. Powder Blender. Ball Mills. Machinecraft Corp., 800 Wilson Ave., Newark 5, N.J. MI 2-7634.

FOR SALE: 1 Baldwin Southwark 150 ton self-contained compression molding press; 1 Modern Plastics 2½" electrically heated extruder, 10 HP; 2 Cumberland 7" stair step dicers, stainless steel; 2 steel jacketed spiral ribbon blenders, 25 and 70 cu. ft.; 4 Ball & Jewell rotary cutters, 2, 7½" 10 and 15 HP; also mills, mixers, etc. CHEMICAL & PROCESS MACHINERY CORP., 52 9th Street, Brooklyn 15, N.Y., HY 9-7200.

FOR SALE: MPH 3½" wire covering Extruder. New ¾" Plastic Extruder and other sizes up to 6", 4 New Farrell Birm. 14" x 30" two roll Mills. Watson-Stillman 240 ton, ten 24" x 56" platens. Baldwin South 200 ton Semi-automatic transfer molding press. Baldwin South 150 ton downstroke 48" x 40" platens. French Oil 120 ton self-contained, upstroke, 29" x 21" platens, 12" stroke. 60 ton Farquhar 50" x 50" platens, 30" stroke. Stokes 50 ton semi-automatic 22" x 12" platens. 50 ton Birdsboro 24" x 20" platens. 30 ton Birdsboro 21" x 14" platens. Hydraulic pumps and accumulators. New ¾ oz. Bench Model Injection Machines. Van Dorn 1 oz. and 2 oz., other sizes to 100 oz. capacity. Baker Perkins and Day jacketed mixers. Plastic Grinders. Seco 6" x 12" and 8" x 16" mills and Calenders. Stokes BB2 and RD3 Rotary-Preform Tablet Machines, also single punch ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Company, 107-8th Street, Brooklyn 15, New York.

FOR SALE: One Extruder—1½" short cylinder MPM complete with 4" tubing die including drive, controls and cooling. May be seen at Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N.J.

1 — OLIVER WRAPPING MACHINE #799-T. 6¾" to 14¾" long, 5½" to 10½" wide, ⅛" to 4¼" high. Wrapper rolls from 6" to 23" wide. For operation on 3/60/220 A.C., Speed 20 to 36 packages per minute. Reply Box #6503, Modern Plastics.

Machinery wanted

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, N.Y. YOnkers. 5-0900, 102 Grove Street, Worcester, Mass. PLeasant 7-7747.

LABORATORY AND TEST Equipment Wanted: Carver, Preco, or Elmes Compression Press; miniature extruder; one ounce or smaller injection machine; 6" x 12" or smaller two roll mill. Also test equipment for tensile properties, impact strength, melt index, etc. Reply Box 6479, Modern Plastics.

WANTED: used small size sheet extrusion installation, suitable for standard and high impact thermoplastics. Also Blow Molding Machine. Purchase of individual items to make up required total installation also favorably considered. List full technical details and others and available accessories, spare screws, attachments, molds etc. Reply Box 6492, Modern Plastics.

WANTED: Number ½ Ball and Jewel Stainless Steel Cutter. Machine to have outboard bearings and be in good operating condition. Reply Box 6501, Modern Plastics.

Materials for sale

FIBERGLAS MAT: Short pieces, short rolls, non standard widths and weights. 50,000 lbs. now available at ½ regular prices and less. Top quality soluble binder and press mat available in addition to a regular supply of cut offs. Reply Box 6474, Modern Plastics.

Materials wanted

POLYESTER RESIN WANTED: Off standard, gelled, discontinued, off color, etc., any quantity. Also, pigments, peroxides, glass cloth and mat, etc. Reply Box 6475, Modern Plastics.

WANTED: All types of plastic scrap and surplus inventories such as: styrenes, butyrates, acetate, acrylics, and polyethylenes, in any form. Write, Wire or Phone Collect. MAdison 3111. Philip Shuman & Sons, 571 Howard Street, Buffalo 6, New York.

PLASTIC SCRAP: Spot basis or contract arrangements. Polyethylene, polypropylene, Nylon, styrene, vinyl, etc. Top prices paid for all scrap in any quantity. Chemsol, Inc., 74 Dod St., Elizabeth, N.J. FLanders 1-2020.

SCRAP VINYL: Wanted to buy VYHH type clear rigid scrap, prefer large continuous lots (20,000 lbs.) from one source. No other vinyl contamination, ground to ¼" flakes. Submit sample together with best price. Reply Box 6481, Modern Plastics.

WANTED: Urgently need any quantity of colored and crystal BUTYRATE SCRAP, Sheet Trim, Purgings, Parts, Reground. CLAUDE P. BAMBERGER, INC., Ridgefield Park, N.J., HUbbard 9-5330.

MANUFACTURERS REPRESENTATIVE: Plastic packaging products and materials wanted for sale in rapidly expanding Southern California market. Opening new office about April 1. Extensive packaging sales and management experience. Well acquainted with large volume package buyers. Strong creative ability. Reply Box 6495, Modern Plastics.

GET THE TOP MONEY FOR PLASTIC SCRAP: Now paying top prices for all thermoplastic scrap. Wanted: polystyrene, cellulose acetate, vinyl, polyethylene, butyrate, acrylic, nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. WRITE, WIRE, TODAY! Reply Box 6496, Modern Plastics.

WANTED: Plastic scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl, George Woloch, Inc., 514 West 24th Street, New York 11, N. Y.

WANTED: cellulose acetate butyrate scrap clear, black, translucent, Reply Box 6502, Modern Plastics.

A. S. FABELTA, Belgian manufacturers of artificial textiles and plastic materials, looking for exclusive representation, for the Benelux countries, of raw materials or semi-finished products in plastic materials. Reply Box 6498, Modern Plastics.

Molds wanted

WANTED: by South-American manufacturer, obsolete molds to purchase or rent for Vacuum Forming. Specify mold material, nature of product dimensions, condition of mold etc. and preferably accompany your offer by drawings or photographs. Reply Box 6491, Modern Plastics.

WANTED FOR EXPORT: molds for all types of plastic articles, injection, blowing, extrusion, vacuum forming, compression and heat sealing. Submit samples, prices and full details to Sovereign International Corp., 144 East 44 Street, N.Y.C.

PLASTIC TOY MOLDS WANTED: Send basic information. Samples if available. Reply Box 6500, Modern Plastics.

Molds for sale

RARE OPPORTUNITY For Sale — 40 Plastic Injection Houseware Molds. Interested in immediate sale. Make offer. Molds can be inspected. Reply Box 6504, Modern Plastics.

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Help wanted

OPPORTUNITIES IN PLASTICS TECHNICAL SERVICE: Immediate openings for graduate chemists, physicists and engineers with three to five years experience in plastics applications work. Background in mechanical behavior and fabrication of thermoplastics preferred. Our new Laboratory provides technical support to leading petrochemical marketer with large polyolefin plant now on stream. Excellent opportunity to grow with us in this new and expanding product line. Positions involve product application studies as well as customer contact work. Send complete resume to: ENJAY LABORATORIES, P.O. Box 175, Linden, New Jersey.

POLYMER CHEMISTS: For challenging positions in expanding natural and synthetic polymers research program. Duties involve development and applications research in plastics and some technical service work. Openings for B.S. or M.S. chemists with interest in re-inforced plastics, coatings, plastisols or in pigment and polymer dispersion. Experience helpful but not necessary. Ground floor opportunity in research program which has quadrupled since 1956. Modern facilities in new 138 lab unit research center to be occupied in late 1960. Good potential for advancement into senior or administrative research positions, market development or technical sales. For detailed information write to G. M. Prust, A. E. Staley Manufacturing Company, Decatur, Illinois.

POLYESTER MANUFACTURER requires experienced plastics engineer to head up development and service group in preform and premix molding. Technical education required. Position offers good starting salary and future opportunity. Liberal benefit plans. Excellent laboratory facilities. Send resume to Mr. E. R. Frank, Pittsburgh Plate Glass Research Center, P. O. Box 127, Springdale, Pennsylvania.

PLASTICS SUPERVISOR: Excellent opportunity for a recent engineering graduate or young man with experience in compression molding. Position is in Plastics Department of a company engaged in the manufacturer of electrical control devices. Send detailed resume to: Mr. William M. Proctor, Personnel Manager, BullDog Electric Products Co., 811 N. Main Street, Bellefontaine, Ohio.

CHEMICAL OR MECHANICAL ENGINEER, familiar with specification, selection, layout and operation of plastics machinery for film, extruding, molding, compounding, coloring and other plastics operations. Career opportunity with leading, fastest-growing, engineer-constructors of polymer and plastics plants. All benefits. Please send us resume in complete confidence. Crawford & Russell Incorporated, 695 Summer Street, Stamford, Connecticut.

SITUATION VACANT in Teheran, Iran, for an experienced engineer as assistant to the executive director. Acquainted with different processes of plastic manufacture. PVC calendering, extrusion. Fully acquainted with all types of raw materials and their suppliers. Apply in detail to Box 6477, Modern Plastics.

CHEMICAL TECHNOLOGISTS: Engineers, chemists, market researchers, for challenging work on polymers, reinforced plastics, fibers, films, adhesives, with expanding consulting organization. Please mail reply to Skeist & Schwarz Laboratories, Inc., 89 Lincoln Park, Newark 2, New Jersey.

WANTED Plant Manager, Southern California to set up, equip and manage new plant for the manufacture of reinforced thermosetting molding compounds. Must have production experience and engineering background with knowledge of high pressure compression and transfer molding fields. Reply Box 6487, Modern Plastics.

PLASTICS ENGINEERS: Brunswick, serving the nation in recreation, education, health, and defense, has outstanding opportunity in our southwestern Virginia Plant. Applicants must have 2 or more years experience in wet lay-up spray process or match metal molding. Degree or equivalent experience required. Company offers top salaries and comprehensive benefits program. Relocation expenses paid. Write Manager of Salaried Employment, The Brunswick-Balke-Collender Company, Marion, Virginia.

FLUOROCARBON PLASTIC REPRESENTATIVES: A medium size processor of Teflon and Kel-F. Complete line. Select territories available. Reply Box 6482, Modern Plastics.

SALES REPRESENTATIVE WANTED: to sell recognized Pearl Essence Pigments. Should know plastic and coating industries. Choice territories still open. Reply Box 6486, Modern Plastics.

PLASTIC FILM SCIENTIST B.S. or M.S. Chemical Engineer or Chemist with 3-5 years experience in the development and/or production of plastic packaging films for excellent career opportunity in Plastic Development work. Send resume of education, specific work experience and salary requirements to: Manager, Industrial Relations, B.F. Goodrich Chemical Company Development Center, P.O. Box 122, Avon Lake, Ohio.

SALESMAN: For plastic injection molding firm to handle sales on straight commission basis. Fast growing company with over a million dollar sales. Territory greater New York, New Jersey, New England areas. Some proprietary items but anxious to develop others. Reply Box 6493, Modern Plastics.

CHEMISTS and chemical engineers. Rewarding Careers Offered Nationally-Important, Dynamically-Expanding, Chemical Organization.
ORGANIC or polymer chemists, BS, MS, or PhD in Chemistry, up to 8 years experience, and a special interest in Research & Development on Polymers.
CHEMICAL ENGINEERS, BS or MS in Chemical Engineering, sound scholastic background, and up to 8 years engineering experience, preferably in development engineering or production. Will work on Process Development and Polymer Research. Location: Tonawanda, N. Y., or Morristown, N. J.
Salary Commensurate with Background and Ability. Generous Company-Paid Benefits. Excellent Growth Potential.
For convenient interview send resume & salary requirements in confidence to: Employee Relations Director, Semet-Solvay, Petrochemical Div., Allied Chemical Corp., 40 Rector St., New York 6, N. Y.

PLASTICS ENGINEER: Johns-Manville Corporation. To do research and development on reinforced plastics products. Must have degree in engineering or chemistry and several years' experience in the plastics industry. Attractive residential areas are near to our Research Center. Please write giving details of education, professional experience and salary requirements to: Professional Personnel Manager, Johns-Manville Research Center, Manville, New Jersey.

PLASTICS ENGINEER, must have technical training and several years experience in extruding and injection molding. Must have tool room experience. Reply Box 6494, Modern Plastics.

TECHNICAL LABORATORY An excellent opportunity for a young man to join the expanding Plastics Division of Spencer Chemical Company. This man should have a degree in engineering or a related field with experience in the field of thermoplastics. He will perform studies on extrusion and molding of polyolefins and nylon and will have some field technical service responsibilities. In reply, please send detailed resume to: Personnel Manager, Spencer Chemical Company, 610 Dwight Building, Kansas City 5, Missouri.

PLASTIC ENGINEER: Openings in Applications Research Laboratory in North Jersey Metropolitan area. Degree in Chemical or Mechanical engineering required; some experience in extrusion, injection molding or compression molding of plastics desirable. Positions involve laboratory applications work and customer service. Liberal company benefits. Send complete resume and salary requirements to: Personnel Department, Plastics and Coal Chemicals Division, Allied Chemical Corp., 40 Rector St., New York 6, N.Y.

EXTRUDER ENGINEERS: National Rubber Machinery has opening in design and development for men experienced in extrusion and blow molding. Please send resume to: B. Frost, National Rubber Machinery Co., West Exchange Street, Akron 8, Ohio.

DEVELOPMENT ENGINEER: Here is a top opportunity for a graduate Ch.E. experienced in polyethylene extrusion to join the research and development team of a growing national flexible packaging manufacturer. The man hired will be responsible for operation and development work for a pilot plant extruder. Salary open. Write Don McConnell, giving full details. The RAP-IN-WAX Company, 150—26th Ave. S. E., Minneapolis 14.

POLYESTER RESIN CHEMIST with B.S., M.S. or Ph.D. degree needed for expanding research department of progressive company. Experience in the field of unsaturated polyester resins is desired. Original work will be encouraged. Liberal benefits. Please send complete resume including present salary to: Dr. Jay E. Meili, Director of Polymer Development, Freeman Chemical Corporation, 211 East Main Street, Port Washington, Wisconsin.

PLASTICS ENGINEER: Attractive opening in engineering research on new polymers. Position carries responsibility and leadership for developing polymer fabrication and polymer application techniques. Applicant should be a graduate Engineer or equivalent with experience in injection molding and extrusion. Suburban Phila. research laboratories offer excellent facilities. Liberal benefits. Please send details of education, experience and personal information to: PENNSALT CHEMICALS CORP., P.O. Box 4388, Phila. 18, Pa.

LEADING N.J. Manufacturer has an opening for an engineer, or chemist capable of supervising a vinyl film to fabric laminating operation. Submit resume to Box 6508, Modern Plastics.

WANTED: Salesman to cover such territories as Ohio, Michigan, Illinois, Indiana, Wisconsin and New York, New Jersey and Pennsylvania. Must have good working knowledge of the entire plastics industry. Will be calling on such companies as injection molders, fabricators of polyester and epoxy resins and extruders. Reply to Box 6507, Modern Plastics.

Situations wanted

JUNE GRADUATE Harvard Business School seeks position in plastics company. Specifically interested in commercial development of new products and ideas. Would like to join my skills in business administration with technical training and experience. Will consider forming new company with technically qualified personnel. Reply Box 6478, Modern Plastics.

PLASTICS ENGINEER—Eleven years' experience in administration, development, materials and process evaluation, trouble-shooting of slushing, roto-casting, laminating, coating, casting, fabricating, compounding, molding, and foaming operations. Some consulting. Minimum salary: $12,500 per year. Northern New Jersey area preferred. Reply Box 6480, Modern Plastics.

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REINFORCED PLASTICS. Presently employed exceptionally qualified manager offers 9 years specialized plus 13 years previous diverse technical and business experience. Specialties include all phases FRP market, product and production process development; technical sales and sales management; full responsibility for successful profitable operation of $1,000,000 business. Inventive problem solver, organization for profit builder-operator. Reply Box 6485, Modern Plastics.

MANUFACTURER'S REPRESENTATIVE, established Indiana, Kentucky and Ohio south of U.S. 30. Selling custom molded rubber parts to Transportation, Appliance and Industrial OEM accounts. Need Custom Injection Molding Co. to 32 oz. equipment. Custom Extruded Shapes Co. to 4 inch equipment. Commission basis. Reply Box 6488, Modern Plastics.

ADVERTISING MANAGER: For raw materials or equipment manufacturer. Excellent experience in all phases of sales promotion—specifically trade shows, direct mail folders, catalogs, brochures, mailing lists, letters, publication ads, publicity and public relations. Understand technicians language and can transmit messages to prospective buyers. Part or full time. New York, New Jersey, Connecticut areas. Reply Box 6490, Modern Plastics.

PLASTICS ENGINEER: Wire and cable seeks demanding responsible position with growing progressive firm, New England location. Strong background in all types of polyethylene, vinyl and nylon extrusions, practical as well as theoretical. 15 years experience in research, development and production. Able to handle and train people. Reply Box 6497, Modern Plastics.

PLASTICS, ELASTOMERS SALES: Age 30, Chemistry degree, 5 years experience selling molded polyurethane elastomers and thermoplastic resins to OEM's and plastics industry. Currently seeking sales and/or administrative position with progressive organization. Prefer New England area. Reply Box 6483, Modern Plastics.

TWELVE YEARS experience in supervisory capacity in injection molding plants. Familiar with most injection molding materials. Presently in charge of molding plant operating on a three shift basis. Details of experience and qualifications upon request. Reply Box 6499, Modern Plastics.

PLASTICS MAN: Young German, at present engaged in Plastic Industry in Melbourne, Australia. Eight years experience in all fields of Extrusion and general Plastic Production. Wide technical knowledge and general business experience, seeks position in the United States. Reply Box 6506, Modern Plastics.

Miscellaneous

WELL-KNOWN BRITISH FIRM forming part of large engineering group and producing substantial quantities of phenolic laminates, flexible insulation, plastics and rubber treated textiles, is seeking lines for expansion where specialised knowhow, patents or capital can restrict competition. The company has adequate technical and financial resources to manufacture and sell in Britain, Europe and the Commonwealth countries. A meeting with any patentee or manufacturer with lines capable of development in these territories would be welcome. Reply Box 6476, Modern Plastics.

SUCCESSFUL SALES ORGANIZATION Available for Exporters to Benelux. Here's a rare opportunity for someone seeking a distribution set-up in the Benelux area! For 12 years, with great success, our firm has represented one of the largest U.S. producers of plastic materials. Only because they are setting up their own organization, we will lose one of our major products. We are seeking new plastic and chemical lines. Excellent references. Offices in Brussels and Rotterdam. Write: IMEXIN S.A., 5, Av. de Broqueville, 15, Brussels, Belgium.

LONG ESTABLISHED plastics (thermosetting) company in big industrial center of Northern Italy to be sold by owner retiring because of age. Land available for future extension. Big up-to-date compression molding plant, modern continuous equipment for production of phenolic molding powders, efficient tool room and metal pressings dept. Fine opportunity for American Chemical Company seeking expansion on European Market. Reply Box 6505, Modern Plastics.

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For purpose of est blishing rate, figure approximately 50-55 words per inch. For further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y. Modern Plastics reserves the right to accept, reject or censor classified copy.

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MODERN PLASTICS

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EDITORIAL

Plastics conventions are improving

The two biggest conferences of the year, the SPE Antec and the SPI Reinforced Plastics Conference, are now history.

Attendance at both broke all records, with 1900 at the SPI meet and 2500 at the Antec. Interest at both was intense, because of the many new developments of the past year and the prospect of more this year.

Attendance at next year's national meetings will, we predict, be still higher, not only because of the technical and volumetric growth of the plastics industries, but also because conventions are improving.

Only five years ago convention platforms were used for "soft sell." There was a constant battle between material makers to get numbers of papers presented. There was a reticence on the part of processors to talk. There were too many papers and in too many cases, men not trained to rostrum work read word-for-word in monotone the papers as already published in the pre-print books. There were too many review papers, too many duplications, too many ivory tower offerings and not enough practical material directed toward application.

We think that the abovementioned two meets showed tremendous progress in conference structure. Total number of papers was drastically reduced. In few cases were review papers allowed. Platform selling was cut considerably. Paper acceptances on briefs were only tentative and final approval was given only to finished papers. Presenters in most cases were prevented by program chairmen from reading the papers. Several presentations were made by material makers' technologists in cooperation with processor engineers.

It has been reasonably estimated that it would take 750,000 man-hours just to read the plastics literature available in the past year. The drastic selection of material to be presented, the elimination of review material, the timing and method of presentation are all designed to use the conference structure to get the most information to the people who need it in the shortest possible time.

In a different type of industrial and technical economy this would be much easier to do. So we must congratulate recent plastics program committees and chairmen for using the democratic process of persuasion and education to accomplish this important purpose.

Hiram McCann

Modern Plastics Executive and Editorial Offices: 575 Madison Avenue, New York 22, N.Y. Tel.: PLaza 9-2710; TWX: NY 1-3063; Cable address: BRESKINPUB.

Handles are for hands and G-E Phenolics are for handles

"It's no accident these cookware handles and knobs are all molded from a single G-E phenolic," reports Bob Appleby, Vice President in Charge of Sales, Harry Davies Molding Co., Chicago.

"The G-E compound imparts good surface finish, outstanding machinability and excellent cutoff characteristics—a combination that makes this an EXTRA-value general-purpose molding material."

Versatile G-E compounds offer a wide range of flows for good moldability of the most intricate parts. New high-density G-E phenolic molding powders with fast curing characteristics increase wearability... lengthen mold life by as much as 40%. For cold powder or preheat applications, light-weight G-E compounds offer high uniformity . . . high strength . . . excellent electrical properties . . . resistance to both chemicals and to heat, impact, vibration.

For further information on the full line of G-E phenolic molding compounds – outlined in a new, 12-page illustrated brochure – write for Catalog CDC-370. General Electric Company, Section MP-40, Chemical Materials Dept., Pittsfield, Mass.

Phenolics-first of the modern plastics ...first in value

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